

Boilerplate text for

Facilities and Other Resources Attachment

for center grant proposals involving investigators in the
Carver College of Medicine at The University of Iowa

TABLE OF CONTENTS (INCLUDED FOR EASE OF REFERENCE ONLY, NOT TYPICALLY INCLUDED)

UNIVERSITY ADMINISTRATION 4

 UI FUNDING..... 4

MAJOR CLINICAL AND RESEARCH BUILDINGS AT THE COLLEGE OF MEDICINE..... 5

 THE UI HOSPITALS AND CLINICS..... 6

 UI STEAD FAMILY CHILDREN’S HOSPITAL..... 6

 THE CENTER FOR DISABILITIES AND DEVELOPMENT..... 6

 IOWA CITY VETERANS AFFAIRS HEALTH CARE SYSTEM..... 7

 MEDICAL RESEARCH CENTER BUILDING 7

 MEDICAL LABORATORIES BUILDING 7

 BOWEN SCIENCE BUILDING 7

 ECKSTEIN MEDICAL RESEARCH BUILDING..... 7

 MEDICAL EDUCATION AND RESEARCH FACILITY..... 7

 CARVER BIOMEDICAL RESEARCH BUILDING 7

 PAPPAJOHN BIOMEDICAL DISCOVERY BUILDING..... 8

 OAKDALE RESEARCH PARK 8

 HARDIN HEALTH SCIENCES LIBRARY 8

CENTRALIZED RESEARCH CORES AND SUPPORT FACILITIES 9

 IOWA INSTITUTE OF HUMAN GENETICS 9

 COMPARATIVE PATHOLOGY LABORATORY 10

 OFFICE OF ANIMAL RESOURCES 11

 BIOMEDICAL RESEARCH STORE 11

 SMALL ANIMAL IMAGING CORE 11

 FLOW CYTOMETRY FACILITY 12

 VIRAL VECTOR CORE..... 12

 GENOME EDITING FACILITY 12

 PROTEOMICS FACILITY..... 12

 BIOENGINEERING FACILITY 13

 CENTRAL MICROSCOPY RESEARCH FACILITY 13

 PROTEIN AND CRYSTALLOGRAPHY FACILITY 13

 ELECTRON SPIN RESONANCE FACILITY 14

 HIGH THROUGHPUT SCREENING FACILITY 14

 SCIENTIFIC EDITING AND RESEARCH COMMUNICATION CORE 14

INSTITUTE FOR CLINICAL AND TRANSLATIONAL SCIENCE 15

 CORES AND CLINICAL UNITS WITHIN THE ICTS..... 16

Clinical Research Resources (CRR) 16

Clinical Research Unit (CRU)..... 16

Flexible Nursing Core 17

Research Coordinator Core..... 17

Biomedical Informatics Core..... 17

Biorepository Tissue and Body Fluid Collection and Storage Core 18

Clinical Research Ethics Consultation Service 18

The UI KL2 Scholars Program..... 18

OTHER RELEVANT UI INSTITUTES AND CENTERS 18

 THE IOWA NEUROSCIENCE INSTITUTE..... 19

 NEURAL CIRCUITS AND BEHAVIOR CORE 19

 THE IOWA NEUROBANK..... 19

THE CARDIOVASCULAR RESEARCH CENTER.....	19
IOWA INSTITUTE OF HUMAN GENETICS	20
IOWA INSTITUTE FOR BIOMEDICAL IMAGING	20
CENTER FOR BIOINFORMATICS AND COMPUTATIONAL BIOLOGY	21
IOWA TESTING PROGRAMS	21
OTHER RELEVANT UI COLLEGES AND DEPARTMENTS	21
DEPARTMENT OF PEDIATRICS	21
DEPARTMENT OF OBSTETRICS AND GYNECOLOGY	22
<i>Iowa Maternal Fetal Tissue Bank</i>	23
DEPARTMENT OF PSYCHIATRY.....	24
DEPARTMENT OF PSYCHOLOGICAL AND BRAIN SCIENCES	25
DEPARTMENT OF BIOSTATISTICS.....	25
<i>Biostatistics Consulting Center</i>	26
THE UI INFORMATION AND TECHNOLOGY SERVICES.....	26

FACILITIES AND OTHER RESOURCES

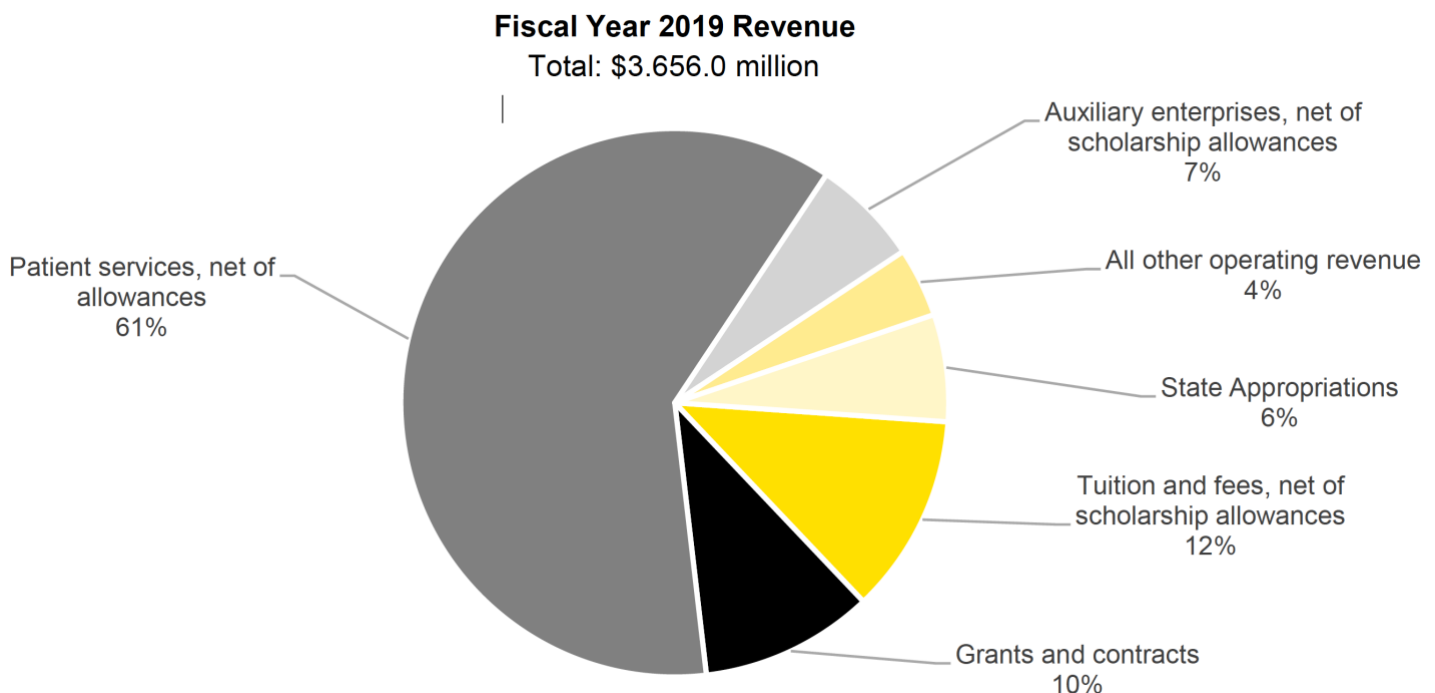
This xxx application relies heavily on a strong institutional commitment to clinical and translational research. In this document, we highlight aspects of the administration, infrastructure, and research cores, as well as the Institute for Clinical and Translational Science (ICTS) and other institutes, centers, and departments at the University of Iowa (UI) that are available and will support the completion of the objective of this application. All key personnel have offices within a 10-minute walk of one another on the campus of the UI and the University of Iowa Hospitals and Clinics, making in-person or virtual meetings and collaboration ideal.

UNIVERSITY ADMINISTRATION

One of three universities operated by the State of Iowa, the UI was established in 1847 in Iowa City. Its full-time faculty numbers nearly 1,800 and serves a student body of ~30,000. A single State Board of Regents is appointed by the governor, and each of the three state universities has a president who reports to the Board of Regents. Mr. Bruce Harreld currently serves as President of UI. Iowa has only one College of Medicine and this resides at UI. The Vice President for Medical Affairs and Dean of the Carver College of Medicine, Dr. Brooks Jackson, oversees all functions of the UI Hospitals and Clinics and the College of Medicine. The CEO of the UI Hospitals and Clinics is Suresh Gunasekaran, who reports to Dr. Jackson. The UI Hospitals and Clinics is the major teaching hospital for the Carver College of Medicine. Education and research activities of the Iowa City Veterans Affairs Health Care System, which is one-half block away, are also under the aegis of the Dean's Office. A central Division of Sponsored Programs coordinates all research administration under the direction of the Vice President for Research (Dr. J. Martin Scholtz). The Carver College of Medicine receives support through the general fund of the UI, whereas the UI Hospitals and Clinics has a separate state appropriation and an independent budget.

UI Funding

In fiscal year 2019, UI received revenue totaling over \$3.6 billion dollars (see chart below). This included \$588 million in grants and contracts. Agencies of the federal government, including the National Institutes of Health, were the largest source of external funds, supplying \$281 million in FY2019. In FY2020, funding for grants and contracts increased to \$666 million (see table below), with \$346 million coming from the federal government. Revenue for the College of Medicine comes primarily from state appropriations, extramural research funding, and clinical practice. In 2020, *U.S. News & World Report* ranked the UI Carver College of Medicine 34th in the area of research among accredited medical schools.



History of Funding Totals (past 5 Fiscal Years*)

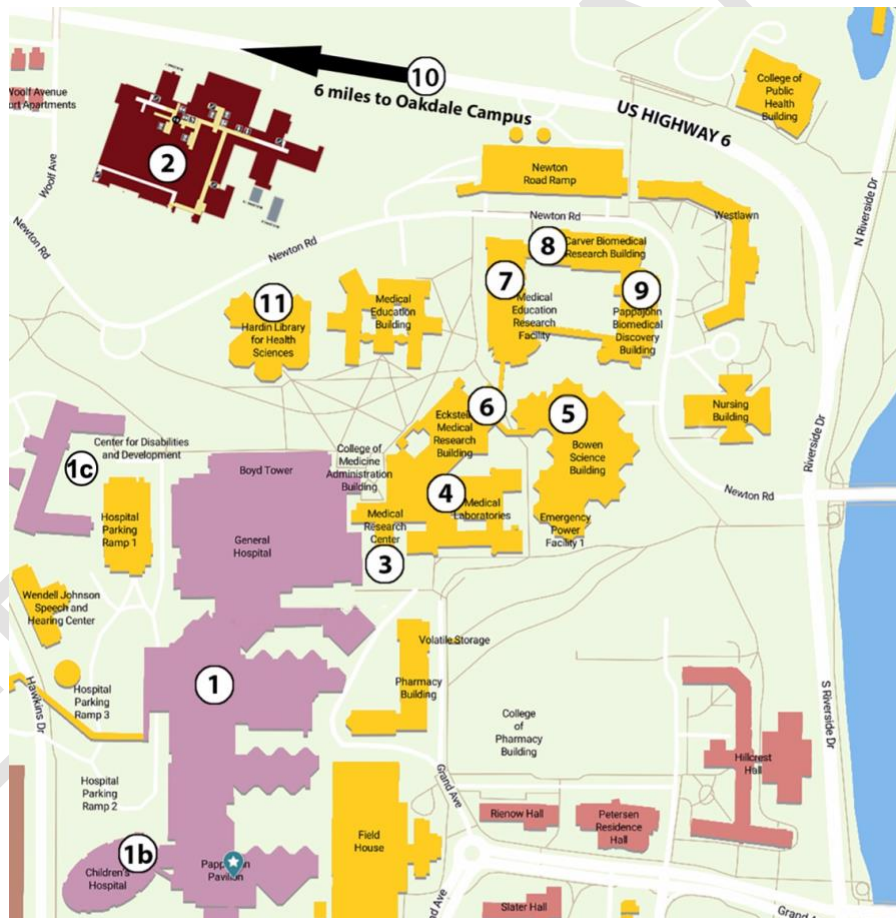
*UI Fiscal Year = July 1–June 30

	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Proposals	3,724	3,846	3,944	3,955	4,117
Proposal \$	\$688,670,148	\$662,127,879	\$664,127,879	\$752,751,957	905,275,441
Awards	2,352	2,447	2,477	2,531	2,537
Award \$	\$437,936,505	\$443,251,636	\$434,522,587	\$588,753,052	\$666,186,459

MAJOR CLINICAL AND RESEARCH BUILDINGS AT THE COLLEGE OF MEDICINE

The UI Hospitals and Clinics and the buildings of the Carver College of Medicine are located on the Health Sciences campus, which is part of the 1,300-acre main campus of the UI. Although the campus in general is large, the medical research buildings are located in close proximity (within a 10-minute walk) and are connected through a network of skywalks that provide easy access to all laboratories and cores included in this P50 and to other centralized research cores.

University of Iowa Health Sciences Campus



- ① UI Hospitals and Clinics
- ①b Stead Family Children's Hospital
- ①c Center for Disabilities and Development
- ② Department of Veterans Affairs Medical Center
- ③ Medical Research Center Building
- ④ Medical Laboratories Building
- ⑤ Bowen Science Building
- ⑥ Eckstein Medical Research Building
- ⑦ Medical Education and Research Facility
- ⑧ Carver Biomedical Research Building
- ⑨ Pappajohn Biomedical Discovery Building
- ⑩ Oakdale Research Park
- ⑪ Hardin Health Sciences Library



The UI Hospitals and Clinics *(see #1 on map above)*

The UI Hospitals and Clinics is the state's only comprehensive academic medical center. The 874-bed teaching hospital complex employs more than 10,000 people and has an annual budget of ~\$1.6 billion. It serves as the tertiary-care center for a region encompassing some four million people in Iowa, Southwest Wisconsin, Northwest Illinois, and Northeast Missouri. Since the early 1970's, there has been an enormous building program involving the construction of new hospital facilities, with the total expenditures for new hospital construction at the UI Hospitals and Clinics exceeding \$1 billion. As a result of this major building program, the UI Hospitals and Clinics is a splendid modern medical facility that provides tertiary care to patients and resources for clinical investigation of the highest quality.

UI Stead Family Children's Hospital *(see #1b on map above)*

Among the new hospital buildings is the new Stead Family Children's Hospital *(see 1b on map)*, completed in 2016. The Stead Family Children's Hospital is the only academic pediatric hospital in the state of Iowa and is home to more than 200 pediatric physicians, surgeons, and dentists, and over 190 pediatric beds. The Stead Family Children's Hospital cared for 77,087 children last year from all 99 Iowa counties, 46 states, and 20 other countries.

The Center for Disabilities and Development *(see #1c on map above)*

The Center for Disabilities and Development (CDD) is a 100,000 square foot facility that is part of the UI Stead Family Children's Hospital and is located adjacent to the main hospital at the UI Hospitals and Clinics. The CDD encompasses the clinic, which provides diagnostic and therapeutic services across the lifespan for individuals with disabilities, and Iowa's University Center for Excellence in Developmental Disabilities (UCEDD), which develops and implements state and community programs to ensure "a life in the community for everyone." The CDD clinic is staffed with experts in the fields of audiology, education, medicine, nursing, nutrition, occupational therapy, pediatric dentistry, psychology, physical therapy, social services, and speech-language pathology. The UCEDD partners with Iowans with disabilities, their family members, providers, state and local agencies, and many others, to improve the health and full community participation of persons with disabilities and to advance the community support and services on which they rely. In addition, the CDD clinic and the UCEDD are complemented by Iowa's Leadership Education in Neurodevelopmental and Related Disabilities program (LEND).

In FY19, CDD activities focused on health, quality assurance, employment, education, assistive technology, and quality of life. The CDD enrolled 57 intermediate and 28 long-term pre-service LEND trainees from 21 disciplines; provided continuing education and training to 8,063 practicing professionals, and provided community training to 2,140 individuals with disabilities, family members, students, and other community members; offered 2,090 hours of technical assistance to community providers, family or consumer groups, state agencies, and policy makers; provided direct services to 7,749 people; engaged in 32 research, evaluation, and/or policy analysis projects; created and disseminated 212 new products; and delivered 67 conference presentations. While impossible to calculate the exact reach of these efforts, it is estimated that the CDD impacted 115,935 individuals during the previous fiscal year.

The Autism Center is a collaborative clinical program also run through the CDD and the Departments of Pediatrics and Psychiatry. The Division of Developmental and Behavioral Pediatrics and the Division of Child and Community Health, both housed within the CDD, facilitate close communication and collaboration in terms of community recruitment of women and children. The statewide Child Health Specialty Clinics, where developmental screening evaluations and telehealth visits are conducted, are administered through the Division of Child and Community Health.

The NIH-funded Attachment and Neurodevelopment Laboratory is situated in the CDD. It includes state-of-the-art equipment designed for recording and analyzing child and parent behavior, including remote-controlled,

high-definition IP surveillance cameras, and one-way observational mirrors. An adjacent room houses the recording hardware and software.

Iowa City Veterans Affairs Health Care System *(see #2 on map above)*

The Iowa City Veterans Affairs Health Care System, with a bed capacity of 93, is adjacent to the UI Hospitals and Clinics. The VA Hospital is completely integrated with the Carver College of Medicine. The same students and house staff provide care in both institutions, and all the VA attending physicians have full faculty appointments at the UI. The VA Hospital has a very active research program; VA research funds awarded annually to its investigators (on average, 60) have been ~\$13.5 million.

Medical Research Center Building *(see #3 on map above)*

The Medical Research Center Building is located between the Medical Laboratories Building and UI Hospitals and Clinics. It physically connects these buildings and consists of about 100,000 square feet of laboratory space. This space was constructed entirely through private donations, which demonstrates the widespread public support for biomedical research within the State of Iowa and the commitment of the UI administration to foster this area of research.

Medical Laboratories Building *(see #4 on map above)*

This building houses the many research laboratories of the clinical departments and a subset of the animal facilities. The Carver College of Medicine has made a major commitment to programs in molecular medicine, including the renovation of two floors of the northeast wing (7,500 square feet) during the past three years. Additional renovations were just completed on laboratories in the southeast wing, including the space dedicated to the Comparative Pathology Core.

Bowen Science Building *(see #5 on map above)*

The Bowen Science Building provides laboratory facilities for most of the basic science investigators in the Carver College of Medicine. This building is adjacent to the Medical Laboratories Building and Eckstein Medical Research Building, and the three are joined by a skywalk and tunnel. Within this building resides the second largest animal-care facility on the UI campus.

Eckstein Medical Research Building *(see #6 on map above)*

The Eckstein Medical Research Building is located adjacent to the Medical Laboratories Building and the Bowen Science Building. This facility provides space for interdisciplinary research programs. A major priority in the assignment of laboratories is to promote and support new interdisciplinary programs. This building also houses several key core facilities including the Electron Spin Resonance Facility, Iowa Institute for Genetics Genomics Division, Central Microscopy Research Facility, the Vector Core, and Flow Cytometry Facility.

Medical Education and Research Facility *(see #7 on map above)*

The Medical Education and Research Facility, completed in 2001, represents phase 1 of a biomedical research facility construction project on the UI Health Sciences campus. It provides 160,000 net square feet, including 100,000 for research. It is connected to the Eckstein Medical Research Building and serves as a focal point for the education and research programs of the Carver College of Medicine. In addition to research and administrative facilities, this structure houses conference facilities and group rooms.

Carver Biomedical Research Building *(see #8 on map above)*

The Carver Biomedical Research Building, completed in 2005, represents phase 2 of the above-mentioned Health Sciences campus construction project. This 130,000-square-foot structure, a linear extension of the Medical Education Research Facility, was dedicated on March 31, 2006. The building houses 40 research modules, numerous specialized laboratory support services, the largest animal facility, and central

administration offices of the Carver College of Medicine.

Pappajohn Biomedical Discovery Building *(see #9 on map above)*

The Pappajohn Biomedical Discovery Building (PBDB), completed in 2015, represents phase 3 of the above-mentioned Health Sciences campus construction project, at a cost of \$150 million. This ~150,000-net-square-foot building has the largest animal vivarium, which significantly enhances the ability for researchers to characterize novel animal models of disease. PBDB is home to the Pappajohn Biomedical Institute, led by Dr. Michael Welsh, which hosts a scientific community that seeks to understand the fundamentals of biology and disease and extend discoveries into real-life applications that improve human health. It is also home to the Iowa Neuroscience Institute, led by Dr. Ted Abel, and houses the 20,000-square-foot Fraternal Order of Eagles Diabetes Research Center (FOEDRC), facilitated through \$25 million in donations for the recruitment of new faculty who conduct diabetes research. Dr. Dale Abel, Director of FOEDRC, has research space in this building. This partnership with the FOEDRC has significantly expanded research in diabetes at UI. In addition, 30,000 square feet of this building are dedicated to the Iowa Institute for Biomedical Imaging (IIBI), which houses the majority of research imaging equipment (for both animals and humans) on campus.

Oakdale Research Park *(see #10 on map above)*

The UI Oakdale campus was constructed in 1991 and is a 15,000 square-foot building that is located six miles west of the UI Health Sciences campus and is served by frequent shuttle service as well as a dedicated limousine/courier service. Constructed in 1991, 15,000 square feet of this research building are dedicated to investigators who are working at new biotechnology companies to apply molecular biology approaches to solve biomedical problems. The Oakdale Campus also houses the State Hygienic Laboratory, large- and small-animal facilities, and a research park in which several companies have constructed laboratories and established new or satellite headquarters.

Hardin Health Sciences Library *(see #11 on map above).*

The Hardin Health Sciences Library is located at the center of the UI Health Sciences campus. It provides books, journals, study facilities, and computer literature search services to all health professionals and other scientists on campus, as well as to practicing physicians and other professionals throughout the state. This 60,000-square-foot building houses 356,034 volumes, and the library subscribes to 2,371 journals (mostly electronic and some hard copy). Library staff and technology are available to assist patrons in designing and executing searches using databases such as: Chemical Abstract Condensates, Biosis Previews, Psychological Abstracts, Biological Abstracts, CINAHL, PsychInfo, CancerLit, HealthSTAR, Current Contents, AIDSline, Bioethicsline; International Pharmaceutical Abstracts, and NTIS.

CENTRALIZED RESEARCH CORES AND SUPPORT FACILITIES

Approximately 60 core facilities and research centers on the UI campus are supported by the College of Medicine, the Office of the Vice President for Research and/or other center grants, program project grants (PPGs), and NIH R01 grants awarded to the UI. These services and facilities enhance the overall research capabilities of the research community immeasurably by providing access to shared equipment and by maximizing the expertise of researchers in a variety of disciplines. A comprehensive list of core facilities, research centers, and research institutes is available on the Carver College of Medicine web site. These Core Facilities are supported in excess of \$3 million annually by the Office of the Vice President of Research and the Carver College of Medicine. The following is a partial list of the available core facilities, focused on those that are most pertinent to the theme of this center.

Iowa Institute of Human Genetics (*Director, Richard Smith, MD*)

The Iowa Institute of Human Genetics (IIHG), directed by Dr. Richard Smith, has three divisions – Genomics, Bioinformatics, and Clinical Diagnostics.

Genomics Division

The Genomics Division, directed by Dr. Kevin Knudtson, provides a broad spectrum of services and resources that include genome sequencing (using next generation sequencing (NGS)), DNA sequencing (using Sanger sequencing), DNA microarray, oligonucleotide, molecular biology computing, and real-time qPCR services. This laboratory occupies a total of ~2,450 square feet of space over six rooms. The director, administrative support, and oligonucleotide service occupy a total of ~425 square feet of office space over two rooms. A custom Laboratory Information Management System (LIMS) has been developed that facilitates sample management throughout the workflow. Users receive all information regarding their sample preparations along with their data. All data are backed up and archived. The service has processed samples using NGS technologies for a complete range of applications including: 1) whole genome sequence analysis, 2) RNAseq (quantification of transcripts and gene expression analysis), 3) single-cell RNAseq, 4) microRNA discovery and quantification, 5) resequencing, 6) ChIPseq, 7) custom target capture, 8) SNP (variant) detection and discovery studies, and 9) ATACseq.

- **Genome Sequencing Service.** This service provides all UI investigators direct access to three Illumina HiSeq systems (2 HiSeq4000s and a HiSeq2500), two MiSeq systems, and an Ion Torrent Personal Genome System for NGS. Sample throughput is facilitated by a Covaris E220 96-well plate sonicator and two Perkin Elmer SciClone NGS sample preparation robots. Support equipment includes: two MJ tetrad thermocyclers, four ABI Model 9700 thermocyclers, and an Advanced Analytical Fragment Analyzer. In collaboration with the Iowa Neuroscience Institute (INI), the Genomics Division purchased a 10X Genomics Chromium Single-Cell System. This allows for high-throughput single cell transcriptomics of many different cell types as well as single-nuclei expression profiling. The flexible workflow encapsulates 100 to 20,000 cells or nuclei per library together with micro-beads into nano-droplets. The resulting data can be analyzed with the free Cell Ranger and Loupe Cell Browser software.
- **DNA Microarray Service.** This service currently uses the Illumina iScan BeadArray and Affymetrix GeneChip Systems. The Illumina iScan Array System can be used to process any of the Infinium arrays used for genotyping, expression analysis, and methylation profiling projects. The service also maintains two complete Affymetrix systems that can be used to process and analyze small feature-size arrays, including whole-genome expression arrays, 1000K mapping arrays, exon arrays and tiling arrays. Following hybridization, the Genomics Division scans the array and provides preliminary analysis of the data. These data are provided in a format that is compatible with most commercial or freeware microarray analysis programs.
- **Real-time PCR Service.** This service provides UI investigators direct access to real-time PCR instrumentation including: two Thermo Fisher Model 7900 HTs systems, a QuantStudio Flex 7 system, a Model 7500 system, and Model 7000 sequence detection systems. The service also supports the Fluidigm EP1 and BioMark systems for use with genotyping and real-time qPCR services, respectively. Investigators

reserve time on these instruments using the online calendar system and bring their ready-to-run plates to the service at the reserved time. The service sets up and runs the instrument, sends the data to the user, and assists with analysis as needed.

Bioinformatics Division

The IHHG Bioinformatics Division, directed by Dr. Michael Chimenti, provides the expertise and equipment to carry out the analysis of complex data sets. In collaboration with investigators both on campus and off, the division studies a diverse set of biological questions. Their focus is to derive biological insights from large, complex data sets generated from large RT-PCR, microarray, and NGS experiments.

The Division is staffed by six people and provides the expertise and equipment necessary to carry out the analysis of complex data sets. The personnel have a mix of experience but generally have specialized experience at the PhD level, in both biology and specifically bioinformatics. The bioinformatics team has broad experience in the analysis of NGS, microarray, comparative genomics, SNP, and proteomics data. They also have experience in programming languages such as Perl, Python, C++, and Java, as well as a working knowledge of statistical analysis, computing clusters, Linux operating systems, storage appliances, and file systems such as ZFS and large partitions. The team has extensive biology knowledge and many years of accumulated research experience in the field of bioinformatics, as well as independence developing strategies for different types of projects. In collaboration with investigators both on and off campus, members of the division study a diverse set of biological questions.

The Division supports NGS analysis through its preferred access to a campus high-performance computing cluster, with high bandwidth dedicated storage attached to the cluster, as well as slower archival storage clusters. The staff also has experience using AWS cloud computing resources to address surge load or novel projects, or to compute configurations. The Division has also developed and optimized a local installation of the Galaxy framework for the evaluation of NGS data, and has developed storage capacity for these data as a resource for both the Division and other users on campus. The Division also supports and develops analysis pipelines in the easy-to-use Galaxy framework. To facilitate this, the staff supports a local mirror of the Galaxy system that allows UI investigators to exploit the full power of the framework, avoiding limitations associated with size restrictions imposed by the Galaxy main system.

Summer courses and other training opportunities are offered through the facility and can provide the interested student or investigator with the skills and resources necessary to participate in or complete their own analyses. The Division offers a yearly three-day course that brings in guest speakers and provides hands-on tutorial sessions. Each year the summer course focuses on a different bioinformatics sub-topic; in past years, this included exome analysis and ChIP-seq analysis. The Division also hosts monthly bioinformatics user group (BUG) meetings that focus on introducing new tools and techniques, as well as providing collaborative connections across campus.

Services of the Division are provided via either a charge-back or a percentage-effort model. This allows for collaboration on both projects that require only routine analysis (charge-back) and projects that involve more in-depth research effort (percentage-effort).

Clinical Diagnostics Division

One of the focuses of the IHHG is bringing personalized genomic medicine to patients across Iowa, and beyond. The broad clinical expertise at the UI Hospitals and Clinics has the unique potential to offer diagnostic genetic testing platforms that target specific phenotypes or patient groups. These tests will be developed by the IHHG before clinical implementation.

Comparative Pathology Laboratory (*Dr. Katherine Gibson Corley, Director*)

The Comparative Pathology Laboratory (CPL) is an animal research support laboratory in the Division of Comparative Pathology (Division Director, Dr. Meyerholz) of the Department of Pathology in the Carver College of Medicine. The mission of this facility is to provide veterinary pathology services and support to scientists investigating animal models of disease. The CPL primarily serves research faculty within the UI, but also works with outside investigators. This core also facilitates analysis of blood and urine chemistries for

assessing disease in live animals, using both VetScan VS2 and Vitros 530 automated instruments. It also provides services for the processing, embedding, sectioning, and tinctorial and immunohistochemical staining of tissues. Expertise in the handling of fresh, frozen, and fixed cells and tissues is the building block of the laboratory.

Office of Animal Resources *(Dr. Jim Sheets, Director)*

The animal resource facilities at UI are extensive. Experimental animals are kept in nine buildings in three distinct geographic locations (east and west sectors of the Main Campus, and the remote Oakdale Campus); ~155,000 square feet are devoted to their care, housing, and related activities. The total cage days of vertebrate animals for the entire university during 2017 was ~9.9 million days. The unit has received full accreditation from the American Association for Accreditation for Laboratory Animal Care (AAALAC). There is a well-established and stringent review procedure for all applications involving animal research at the UI, and it meets with the standards set forth by the American Physiological Society. The Medical Education and Research Facility and Bowen Science Building on the main campus, as well as the Transgenic Animal Facility on the Oakdale Campus, contain modern, rigorously-maintained BSL2-Level animal quarters staffed by highly trained technical support personnel. In addition, the UI College of Medicine/Hospitals and Clinics is among the few medical centers in the United States that have an authorized program for utilizing hospital equipment to perform animal studies. Animal studies have been performed in the Ultrafast Computed Tomography (CT) Facility, the Nuclear Magnetic Resonance Imaging Facility, and the Positron Emission Tomography Imaging Center. All aspects of the animal care program at UI are superb, and it has been an enormous asset to investigators performing research requiring experimental animals of various species.

Biomedical Research Store *(Dr. Kevin Knudtson, Director)*

Located on the second floor of the Eckstein Medical Research Building, the 2,500 square-foot Biomedical Research Store provides UI researchers easy procurement of common molecular and cell biology enzymes, reagents, and kits. The molecular biology reagents include, but are not limited to, restriction and other DNA modifying enzymes, DNA and RNA purification kits, competent cells, quantitative (“real-time”) PCR chemistries and consumables, and nucleotides. Tissue-culture reagents include, but are not limited to, antibiotics/antimycotics, dissociation enzymes, growth factors, media, media supplements, salt solutions, serums, transfection reagents, and endotoxin-free water. Large-volume contracts enable the store to negotiate low prices, as well as eliminate shipping and packaging fees. Products are available at walk-up windows located on the second floor of the Eckstein Medical Research Building. This service provides investigators with convenient and rapid access to small quantities of enzymes, in many cases eliminating the need for individual laboratories to maintain expensive inventories.

Small Animal Imaging Core *(Dr. John Sunderland, Director)*

The Small Animal Imaging Core (SAIC) is a core facility of the Iowa Institute for Biomedical Imaging (IIBI) and the Holden Comprehensive Cancer Center (HCCC). The purpose of SAIC is to provide a comprehensive service for non-invasive anatomical and physiological imaging of small animals (mice, rats, ferrets, etc.) and other biological tissue samples. Core instrumentation consists of several imaging modalities that have been specifically purchased or modified for scanning small animals. Imaging services include microPET imaging, gamma camera scintigraphy, whole tissue biodistribution assays and autoradiography using positron emission tomography-computed tomography (PET/CT), and single-photon emission computed tomography (SPECT/CT). The SAIC staff assists investigators with defining which one or more of the imaging modalities are appropriate for their research needs. This assistance encompasses the choice of the most appropriate radiopharmaceutical and imaging methodology to capture the physiological process of interest. The core works with investigators to develop a timetable for experiments, determines the numbers of animals required to demonstrate feasibility and/or significance, and assists the research team with the development of imaging sequences and image analysis schemes. The core has the capability to serially image awake and anesthetized animals. The staff will also assist with collaborations between HCCC investigators and other experts across the UI campus to facilitate the investigation of new radiopharmaceuticals, contrast media, drugs, therapeutic

interventions, or other specialized techniques that may be necessary for specific experiments. For PET imaging, the radiopharmaceuticals that are currently available are FDG ([¹⁸F]fluorodeoxyglucose), FLT ([¹⁸F]fluorothymidine), acetate ([¹¹C]acetate), choline ([¹¹C]choline) and others. FDG is routinely available on a daily basis. All other available PET radiotracers require schedule coordination with radiochemistry staff. If PET radiotracers other than those listed above are desired, Dr. David Dick is consulted on the potential availability and cost.

Flow Cytometry Facility (*Dr. Zuhair Ballas, Director*)

The 1,200 square-foot Flow Cytometry Facility is located in the Eckstein Medical Research Building. The facility has one magnetic-based and ten laser-based instruments which are used to identify and isolate various cell populations, and quantify hormones and cytokines. The specific instruments in the facility include: Becton Dickinson Aria II, Becton Dickinson FACS DiVa, Becton Dickinson LSR II with 355nm, 488nm, and 633nm lasers, Becton Dickinson LSR II with 405nm, 488nm, 561nm, and 639nm lasers, Becton Dickinson LSR II (VA satellite lab) with 405nm, 488nm, and 633nm lasers, Becton Dickinson FACS Calibur, Becton Dickinson FACScan, BioRad BioPlex, Miltenyi autoMACS. The facility provides scientific and technical personnel who are available for consultation in designing experimental protocols and training in the use of bench-top instruments and software programs for the interpretation and analysis of data. Cell preparation protocols and publication-quality output are available upon request. Data analysis using FlowJo™, Cellquest™, and ModFIT™ can also be performed offline at investigator laboratories or offices using the Facility's system of networked computers, which can be accessed via its dedicated file server. Data are archived on a separate server and stored for at least ten years.

Viral Vector Core (*Dr. William Paradee, Director*)

The overall objective of the Viral Vector Core is to support investigators in the use of gene transfer technologies. This core utilizes molecular biology techniques to engineer and develop viral vectors based on multiple vector systems necessary for gene transfer in research experiments or pre-clinical studies. Staff and investigators work together, allowing for cross-fertilization of ideas, technical advancements, and innovations in vector design. The core brings investigators who are interested in developing and using viral and non-viral vectors for gene transfer together with specialists in the area of vector construction, by: 1) consulting with the principal investigator to plan and develop transfer vectors that fit individual project requirements, 2) assisting investigators with troubleshooting for existing projects, 3) designing and developing novel vectors, 4) developing novel methods of virus production such as the RapAd™ System for adenovirus production, 5) generating RNAi expression vectors, 6) constructing, amplifying, purifying, concentrating, and performing quality control on preparations of recombinant adenovirus, adeno-associated virus (AAV), Moloney murine retrovirus, lentivirus, recombinant vaccinia virus, and baculovirus; 7) helper-dependent Adenovirus (i.e., gutted with no viral genes), and 8) maintaining and distributing recombinant reporter viruses.

Genome Editing Facility (*Dr. William Paradee, Director*)

The Genome Editing Facility provides centralized instrumentation and expertise for the generation, breeding, and analysis of both transgenic and gene-targeted animals. The facility is comprised of four personnel trained in a variety of mouse embryo manipulations for producing genome-engineered mice. This includes transgenesis and CRISPR/Cas9 HDR approaches using pronuclear microinjection. Additional services include the design and validation of transgenic constructs and CRISPR/Cas9 reagents, screening of founder animals, genotyping of mouse colonies, and backcrossing of strains. The facility also provides services and storage for embryo and sperm cryopreservation, as well embryo and mouse re-derivation and *in vitro* fertilization of cryopreserved sperm. The facility evaluates and expands mouse embryonic stem cells, and injects them into blastocysts. It maintains all animals in strict specific pathogen free (SPF) barrier conditions and has three wet laboratories, a microscopy suite, a tissue culture room, and a molecular biology laboratory. The facility currently has a 100% founder success rate, with nearly 300 different constructs.

Proteomics Facility (*Dr. Marshall Pope, Director*)

The Proteomics Facility, located on the third floor of Eckstein Medical Research Building, provides services and state-of-the-art instrumentation for discovery proteomics or more in-depth quantification studies. Services currently available in the facility include: molecular weight determination of intact proteins and macromolecules, small molecule structural and quantitative analyses, protein identification following proteolysis in polyacrylamide gels or solution, applying MASCOT, SEQUEST or SpectrumMill search engines, as well as characterization of certain post-translational modifications. Equipment in the Facility includes a Bruker UltrafleXtreme MALDI TOF/TOF, a Thermo LTQ XL linear ion trap with electron transfer dissociation capabilities and an atmospheric MALDI source, an Agilent 6520 quadrupole time-of-flight (Q/TOF) with routine 10 ppm mass accuracy, an Agilent 6400 triple quadrupole (3Q) for tandem MS/MS scanning, especially multiple reaction monitoring. The Agilent instruments are interfaced to state-of-the-art, ChipCube platforms driven by Agilent 1200 nano- and capillary HPLC pumps. Matched Dionex 3000 RSLC two dimensional capillary systems are interfaced to a Proteiner II robotic fraction collector (for off-line separation prior to MALDI MS/MS) and the Linear Trap Quadrupole. The matched liquid chromatograms for ESI and MALDI are used to build accurate mass and retention time libraries for tissue archives. Associated equipment includes a Dionex ICS 3000 for glycoproteins or chromatofocusing, an automated digester, electrophoresis units, an OffGel Fractionator and an Eksigent 2D nanoLC to partition complex peptide mixtures using isoelectric focusing or strong cation exchange (SCX) chromatography.

Bioengineering Facility (*Douglas Wichhart, Director*)

The Bioengineering Facility maintains two units for the design of new equipment and the maintenance of research or other electronic equipment. The design unit offers custom electronic design and fabrication services. Capabilities include embedded micro-controllers, digital signal processing, custom programmable logic devices, computer interface, and high-performance analog amplification and signal conditioning. The maintenance section repairs electronic equipment and schedules regular maintenance inspections.

Central Microscopy Research Facility (*Randy Nessler, Director*)

The Central Microscopy Research Facility (CMRF) provides instrumentation and technical assistance to research programs involving the use of scanning and transmission electron microscopy, light microscopy, confocal microscopy, freeze fracture, and x-ray microanalysis. The CMRF provides all solutions, supplies, and training necessary for investigators involving microtomy, including specialized staining and embedding techniques; negative staining; metal coating; immuno-cytochemistry; morphometry and stereology; and the preparation of material samples for both transmission and scanning electron microscopy, including x-ray microanalysis and other procedures. Basic equipment includes: Olympus BX-51 and Nikon Optiphot light microscopes equipped for brightfield, darkfield, and phase, Hitachi scanning electron microscopes, and JEOL and Hitachi transmission electron microscopes. The facility has a Bio-Rad Radiance 2100MP multiphoton/confocal microscope, a Bio-Rad MRC-1024 confocal microscope and several Zeiss 510 confocal microscopes. The facility has Kratos Axis Ultra X-Ray photoelectron spectroscopy system, VEECO/DI Multimode IV Scanning Probe microscope and Asylum Research atomic force microscope. The facility has a Xenogen IVIS 200 system that allows researchers to use real-time imaging to monitor and record cellular and genetic activity within a living organism. Additional equipment includes a Balzers HPM-101 high-pressure freezer, a Balzers 301 freeze fracture system, a Leica cryosubstitution unit, Reichert and Leica ultramicrotomes and a digital darkroom/image editing workstation. Microscopy courses and workshops by staff are regularly offered free of charge. The CMRF recently installed a stimulated emission depletion (STED) microscope for ultra-high-resolution microscopy.

Protein and Crystallography Facility (*Dr. Lokesh Gakhar, Director*)

The Protein and Crystallography Facility provides all support and infrastructure necessary for initiating and completing protein purification, biophysical characterization, and structural studies. This includes three BioRad DuoFlow FPLCs for protein purification, a Wyatt NanoStar dynamic and static light scattering instrument for aggregation and protein size determination, a ForteBio Octet RED96 biolayer interferometry system for protein:protein and protein:DNA binding studies, a thermal shift assay workflow to identify protein stabilization

conditions using a BioRad CFX96 qPCR instrument, a TTP LabTech Mosquito nano-volume robot for arraying multiple crystallization conditions, a Formulatrix RockImager2 for imaging crystal trays, and a TTP LabTech Dragonfly liquid-handling robot for preparation of custom solution arrays. Diffraction data can be collected locally using two R-AXIS IV++ systems mounted on rotating anode generators or by shipping to our 4.2.2 Molecular Biology Consortium beam line at the Advanced Light Source (Lawrence Berkeley National Laboratory), where data collection is performed remotely from Iowa. The facility also enables analysis by small-angle X-ray scattering (SAXS) in line with size exclusion chromatography (SEC) and multi-angle light scattering (MALS). Data are routinely collected in person from the 18-ID-D Bio-CAT beam line at the Advanced Photon Source (Argonne National Laboratory), or via a mail-in system from the 12.3.1 SIBYLS beam line at ALS. The facility is also set up with several workstations and an SBGrid Consortium membership, which provides updated versions of all necessary structural biology and molecular modeling software.

Electron Spin Resonance Facility (*Dr. Garry Buettner, Director*)

The Electron Spin Resonance Facility provides expertise and instrumentation to pursue research questions dealing with oxygen free radicals, singlet oxygen, nitric oxide, and the array of related oxidants and antioxidants that influence the overall redox environment of cells, tissues, and whole organisms. The facility houses two Bruker EMX ESR Spectrometers and a Varian E-4 ESR.

High Throughput Screening Facility (*Dr. Meng Wu, Director*)

The UI High Throughput Screening Facility (UIHTS) provides a high-throughput platform that integrates robotics, detection systems, and chemical/biologic libraries to enable highly flexible screening services, project management, grant assistance, and assay/technology development for UI investigators. Instrumentation systems allow for scalable screening toward drug discovery and development, including the screening of large chemical/biologic libraries. This facility also enables molecular probe discovery for mechanism-of-action studies by screening focused and intellectually-designed compound collections. The UIHTS is equipped to perform high-throughput screening in 96-, 384-, and 1536-well formats with plate reader detection (Perkin-Elmer EnVision), using absorbance, fluorescence, and luminescence (including advanced FRET and BRET techniques). UIHTS is also equipped to perform high-content screening (HCS, Perkin Elmer Operetta Confocal Imaging System) based on the detection and quantification of: phenotypic changes, i.e., cell differentiation, cell migration, neurite outgrowth, and target trafficking; changes in the fluorescence intensities of target proteins, including transcription factors; or signaling pathway activity. HTS and HCS systems are integrated with robotics systems for plate handling and assay execution, and are suitable for small- or large-scale compound library screens that are fully automated. UIHTS holds both small-molecule drug libraries and biological libraries. Currently, the small-molecule libraries include: 1) a drug library that contains 1,018 FDA-approved compounds and is used primarily to identify drugs that can be repurposed; 2) a pathway- or target-selective collection (PTSC) containing 1,310 compounds for mechanism interrogation; 3) the Spectrum Library from MicroSource (MSSP), which contains 2,320 structurally diverse compounds, including marketed and experimental drugs as well as natural products (this is typically the starting point for pilot screens); 4) the ChemBridge Diverset, a collection of 50,000 small molecules that represent a wide swath of chemical space and are optimized to be “drug like” considering factors such as partition coefficient and Lipinski-like rules; 5) the Maybridge Ro3 Diversity Fragment Library, which contains 1,000 fragments that were carefully selected to optimize the balance between broad coverage of lead-like diversity space and the number of fragments; 6) the NIH NCI NExT collection of 83,536 small molecules, a general screening set that was designed to identify lead compounds for drug discovery projects and that is comprised of three non-separable subsets of the Legacy molecular library small molecule repository (MLSMR), 15 privileged scaffolds in two Diversity subsets. Biological libraries cover the cell collections of melanoma cell lines and breast cancer cell lines, and arrayed Kinome-wide CRISPR gRNA library from Integrated DNA Technologies.

Scientific Editing and Research Communication Core (*Dr. Christine Blaumueller, Director*)

The Scientific Editing and Research Communication Core (SERCC) helps researchers succeed with their funding efforts and scholarship by providing in-depth advice on how to maximize the clarity of scientific

documents. The core is staffed by scientists with advanced degrees who offer detailed editorial review of grants, manuscripts, and other writing projects based on extensive experience in both laboratory research and editing of scientific content. Multiple levels of feedback are offered, including:

- Mechanics: proofing for grammar, typographical, and other errors
- Style and clarity: suggestions toward improving text flow
- Presentation: suggestions toward highlighting the significance of the research, and in the case of multi-project documents, achieving a single voice
- Science: pre-review from the perspective of a non-specialist reviewer; on request, feedback on how well scoring criteria for grants are covered.

Authors receive an annotated copy of their submission and can request one-on-one meetings at any time to discuss writing strategies, clarify their meaning, or discuss potential problem spots. Core staff also participate in didactic teaching of scientific writing. The Iowa Neuroscience Institute fully subsidizes editing costs for all of its investigators, which includes many who conduct research on intellectual and developmental disabilities.

INSTITUTE FOR CLINICAL AND TRANSLATIONAL SCIENCE

Approved by the Iowa Board of Regents in December 2006, the Institute for Clinical and Translational Science (ICTS) is the epicenter of clinical and translational science at UI and serves as the academic home for the clinical and translational research and training conducted here. Funded by an NIH Clinical and Translational Science Award (CTSA) grant, it provides an area of great opportunity and future growth for clinical and translational researchers. The ICTS is directed by Dr. Patricia Winokur, and its unique overarching academic structure provides a multidisciplinary matrix for facilitating and supporting clinical and translational science throughout the UI colleges as well as the UI Hospitals and Clinics. ICTS functions include:

1. *Stimulating new interdisciplinary clinical research programs to consolidate and improve the UI research infrastructure.* The ICTS brings together existing UI programs and leaders in the major domains of clinical research, facilitating the transfer of knowledge across these domains and into the community.
2. *Training highly motivated clinical research scholars for innovative careers in patient-focused research.* The ICTS training programs provide a diverse and comprehensive curriculum across a spectrum of clinical research fields, as well as abundant opportunities for close supervision by mentors from not only the Carver College of Medicine but also several other colleges (Dentistry, Nursing, Law, Pharmacy, Public Health, Engineering, Liberal Arts and Sciences).
3. *Providing a useful and integrated foundation for data and knowledge management capable of supporting the advancement of clinical and translational research on a grand scale.* Data- and knowledge-management comprise a key foundation for other functions of the ICTS. The specific functions of the biomedical informatics endeavors of the ICTS are to: develop a federated infrastructure capable of capturing, archiving, and managing all the forms and media of the UI research outcomes; disseminate results to authorized UI personnel for translational use; provide for the secure dissemination of biomedical information to authorized individuals in extramural organizations; and participate in the national initiative to work with extramural organizations, and to integrate work at UI with that performed at institutions throughout the country.
4. *Provide engaging community programming driven by the principles of community-based participatory research.* The ICTS community engagement activities, driven by accepted principles of community-based participatory research, create and nurture a wide range of project types. The long-term goals of these activities include: decreasing disparities in clinical research participation by underserved populations; enhancing community trust in clinical and translational research; identifying the research priorities and needs of patients; engaging community providers in meaningful ways to conduct clinical research; and, facilitating the recruitment of research participants from the community.
5. *Strengthening the UI research infrastructure.* Classified as a "very high research activity" research university by the Carnegie Foundation, the UI's already strong infrastructure is enhanced by the key functions of the ICTS in the following areas:

- Clinical Research Resources – Provides investigators with the physical setting and infrastructure needed for inpatient and outpatient clinical and translational research at UI, as well as access to and training in sophisticated, state-of-the-art technologies for clinical and translational research.
- Regulatory Knowledge and Support and Ethics – Monitors the safety of research participants, helps investigators comply with institutional and federal research regulations, and assists in the preparation of safety plans, and manages the regulatory process.
- Pilot and Collaborative Translational and Clinical Studies – Provides financial support for pilot grants, encouraging the expansion of clinical and translational research into new areas and attracting scientists to the field.
- Development of Novel Clinical and Translational Methodologies – Encourages individuals to make scientific advances and develop new technologies, as well as to file patent applications and commercialize their research.
- Genetics and Genomics – Helps accelerate gene discovery by providing analytic tools and expertise needed for convergent genomics, as well as DNA processing and genotyping services.
- Research Education, Training and Career Development – Trains highly motivated scholars and participating staff for careers in clinical and translational research.
- Clinical and Translational Research in Pediatrics – Focuses on bringing research from the laboratory to children in Iowa and around the world.
- Community Engagement – Nurtures interactions between UI researchers and members of communities across Iowa and the nation.
- Biomedical Informatics – Establishes and maintains information technology infrastructure to support clinical and translational researchers within UI and across the national consortium.
- Biostatistics/Epidemiology/Research Design – Helps ICTS investigators select and implement research designs and statistical analysis methods appropriate for their individual projects.

Cores and Clinical Units within the ICTS

ICTS administration is housed in an over 10,000 square-foot space in Boyd Tower of the General Hospital within the UI Hospitals and Clinics. This space is dedicated to administrative, faculty, and staff offices, as well as several large, modernized conference/class rooms. The ICTS also dedicates areas to bioinformatics. These consist of ~5000 square feet of data-center space in the Medical Research Center Building. The following Cores and Clinical Units are managed by the ICTS.

Clinical Research Resources (CRR)

In order to bring discoveries to patients, there must be places where clinical research studies can take place, as well as skilled staff to ensure high-quality, safe research practices. The ICTS CRR provides these facilities for investigators conducting inpatient and outpatient clinical and translational research at UI. The CRR include a clinical research unit (supporting both outpatient and inpatient studies) and a Flexible Nursing Service (supporting pediatric, neonatal, infant, and pregnant subjects who are unable to come to the main Clinical Research Unit).

Clinical Research Unit (CRU)

The CRU of the ICTS provides the infrastructure and physical setting necessary to perform both inpatient and outpatient clinical and translational research. The CRU has provided services to UI investigators for over 50 years (originally as the General Clinical Research Center, and currently as part of an NIH-NCRR Clinical and Translational Science Award). The CRU is a 20,000 square-foot state-of-the-art facility located in Boyd Tower. This unit has five inpatient rooms with nine beds, and space devoted to outpatient and laboratory facilities. The CRU staff includes one nurse manager, five staff nurses, three medical assistants, one clinical technician, and two laboratory technicians. The entire nursing staff is extensively involved in protocol implementation and has

been trained in the protection of human subjects and good clinical practice. During inpatient trials, the CRU nursing staff provides coverage for patient assessments, timed data collection, administration of investigational therapies, monitoring for adverse events, and accurate data documentation.

The CRU includes five core laboratories that support UI investigators.

- **Analytical Laboratory:** UI investigators can perform enzyme-linked immunosorbent assay (ELISA), radioimmunoassay (RIA), high performance liquid chromatography (HPLC), mass spectrophotometry, and other blood chemistry tests in this fully equipped laboratory.
- **Bionutrition Laboratory:** Laboratory staff assist UI investigators with the nutrition components of their research protocols. This laboratory includes a 400 square-foot metabolic kitchen and dining area equipped to prepare and serve controlled diets, test meals, and custom recipes.
- **Bone Density Laboratory:** UI investigators can assess bone density in adults and children using Dual Energy X-Ray Absorptiometry (DXA) and/or peripheral quantitative computerized tomography (pQCT). Equipment consists of a Hologic Delphi bone densitometer and Stratec PQCT 2000 and 3000. Also, an Ambulatory Blood Pressure Monitoring Laboratory offers specialized equipment to record and analyze blood pressure over an extended period.
- **Cardiovascular Human Physiology Laboratory:** UI investigators may perform comprehensive assessments of cardiovascular function. Parameters measured include vascular blood flow, cardiac rhythm, cardiac output, and vascular ultrasound studies.
- **The Pulmonary Physiology Laboratory:** UI translational investigators can access equipment, as well as expertise, in measuring research participants' lung function and responses to exercise. Laboratory staff also assist in the collection and analysis of biologic samples from subjects' lungs.

Outpatient clinical space is also available and includes 16 exam rooms and six consult/interview rooms, an infusion suite with seven carrels, and a procedure suite. Vitals and phlebotomy rooms are also housed within the unit. The CRU also has facilities for blood and body fluid processing. Centrifuges, refrigerators and -80°C freezers, used for sample storage, are alarmed and monitored continuously. In addition, crash carts, EKG machines, electronic and manual blood pressure monitors, exam tables, a medication preparation room, and computer facilities are available. The CRU also supports investigators by assisting in study design and coordinating research activities, and aids in various interactions with research subjects, such as scheduling, gathering their information, monitoring vital signs, collecting samples, and assisting with study protocols. Biostatistics and informatics support, as well as assistance with regulatory compliance and safety plans, are also available.

Flexible Nursing Core

The ICTS offers a flexible nursing service. Flex nurses are assigned to perform duties throughout the hospital's other units, such as the neonatal intensive care unit and newborn nurseries, the mother/baby care unit, and labor and delivery unit. They provide coverage 24 hours a day, 7 days a week.

Research Coordinator Core

This service is available to all UI investigators. The Core staff helps investigators organize and facilitate research studies, which is particularly helpful to junior investigators, who often cannot support a full-time coordinator and who benefit from internal grants to subsidize the costs of the service. The services offered include part-time and/or short-term support of a clinical research coordinator, coordination of research and consulting regarding budgeting/billing guidelines, job descriptions and advertisements, etc., and assistance with the forms (e.g. IRB, FDA, budget, protocol) that are required to initiate patient-oriented research studies.

Biomedical Informatics Core

The Biomedical Informatics Key Function (BMI) has developed a strong personnel and technical infrastructure *de novo* to meet the informatics needs of the UI translational research community. They support a full spectrum of activities across a range of computational disciplines, including imaging, genomics, and analysis of

large healthcare databases. In addition, they have driven innovation locally, in relation to high-performance computing, research storage solutions, and informatics tools for research profiling, thereby improving the efficiency of both the IRB application process and the collection of patient-reported outcome measures through personal health records. The overall informatics environment, both computational and storage, supports a broad range of investigator requirements, ranging from single-investigator R01 grants to large, high-impact, multi-site NIH studies and contracts (e.g., National Children's Health Study). The goal of establishing the BMI was to shift investigator informatics activities from dispersed, variably managed systems to a well-managed analysis and storage environment with appropriate security controls. Collaborating with campus and hospital IT security groups, BMI developed a security framework involving multiple layers. These range from simple firewalls that restrict access to servers managing non-sensitive data through personal-health-information-carrying servers that are certified as FISMA-moderate and are housed alongside UI production servers. The individual servers that comprise the network are managed in secured, audited machine rooms and are subject to regular security scans. The range of security levels allows matching of the degree of data sensitivity to the storage environment.

Biorepository Tissue and Body Fluid Collection and Storage Core

The Biorepository Tissue and Body Fluid Collection and Storage Core (i.e., the UI Biobank) facilitates clinical and translational science by making a large set of DNA and tissue samples and associated health information available for research use. Investigators wishing to use samples and health information stored in the UI Biobank may apply for access to this resource; if the application is approved, they receive samples and data that have been de-identified and coded with a research ID. ICTS staff are also available to advise researchers wishing to develop their own biobanks or genetic studies and can support DNA extraction or genotyping on a pilot-project basis. Investigators can request advice on study design, grant preparation, IRB protocol development, study coordination, subject recruitment, sample collection, and database management. Laboratory services range from storage of existing specimens, to DNA extraction and genotyping. A DNA freezer storage facility of ~1,100 square feet is located in the Medical Laboratories building.

Clinical Research Ethics Consultation Service

This service provides free consultation on ethical issues related to research design, tissue banking, genetic research results, informed consent, and working with vulnerable patient populations. In particular, clinical investigators are assisted in identifying and addressing the ethical challenges that frequently arise in studies involving human subjects. Examples of topics include: ethical challenges in sampling design; randomized and placebo-controlled studies; participant recruitment and informed consent; return of individual-level research results; and community engagement processes.

The UI KL2 Scholars Program

The goal of the KL2 Scholars Program is to recruit and train outstanding scholars who will be engaged in an individualized curriculum and in mentored health care research up to a three-year period in this multidisciplinary, multicultural KL2 program. The KL2 program enhances the mentoring environment for translational research scholars through a robust program for both mentors and mentees built on the National Research Mentoring Network training platform, and provides a highly focused mentored research experience that fosters scholars' successful transition to independence and continued engagement as leaders of translational health care teams. The KL2 Scholars Program provides 75% salary support for 4 scholars a year (up to \$85K inclusive of fringe). The Scholar's home department guarantees a 3rd year of salary support at 75% effort should the scholar not obtain independent funding by the end of Year 2. Dr. Alex Bassuk is PI of the KL2 program.

OTHER RELEVANT UI INSTITUTES AND CENTERS

The UI Carver College of Medicine has been an international leader in interdisciplinary research, beginning with its establishment of the Cardiovascular Research and Training Center in 1975. It has since evolved significantly and currently includes the Cystic Fibrosis Research Center, the Cystic Fibrosis Clinical Center, the Cooperative Human Linkage Center, the Helen C. Levitt Center for Viral Pathogenesis and Disease, the Center for Gene Therapy of Cystic Fibrosis and other Genetic Diseases, the Center for Macular Degeneration,

the Alzheimer's Disease Research Center, the Fraternal Order of Eagles Diabetes Research Center, the Iowa Neuroscience Institute, and 19 specialized centers funded by program project and other complex research grants. **There are few medical schools at which the environment for interdisciplinary research is richer and deeper than at UI**, and this atmosphere is strongly fostered by the current leadership of the College of Medicine. A subset of the above-listed entities is described below.

The Iowa Neuroscience Institute (*Director, Dr. Ted Abel, PhD*)

The Roy J. Carver Charitable Trust committed a transformational \$45 million grant to the UI that allowed for the creation of a comprehensive and cross-disciplinary neuroscience center within the Carver College of Medicine. Led by Dr. Ted Abel, the new Iowa Neuroscience Institute (INI) conducts research to find the causes of — and preventions, treatments, and cures for — the many diseases that affect the brain and nervous system. Since the founding of the INI, 17 tenure track faculty have been recruited, representing an investment of over \$10 million. Collaborative opportunities and interactions are plentiful as the INI includes over 100 faculty members across 26 departments and seven schools. To further enable scientific interactions, there are weekly INI collaboration seminars designed to allow helpful discussions of ongoing experiments with other postdoctoral scholars, students, and faculty members. The INI also sponsors weekly formal meetings, which vary from journal clubs to outside guest speakers. These involve informal meetings between students, postdoctoral researchers, and outside speakers, fostering an environment of training and networking for all levels of researchers. These meetings also include general laboratory presentations, which are designed to allow postdoctoral researchers and students to meet and present their work in front of experts in the field. The INI is also closely connected with the Neuroscience graduate program that hosts weekly seminars for graduate students. This setting allows students to help each other, whilst also building presentation and scientific research skills. Overall, the environment at the UI is designed to foster the presentation and scientific skills of all levels of neuroscientists, and to facilitate collaborations with scientists across disciplines.

Neural Circuits and Behavior Core (*Director, Dr. Shane Heiney, PhD*)

The Neural Circuits and Behavior Core (NCBC) was created within the Iowa Neuroscience Institute (INI) to enable members of the UI to perform transformative research on neural circuit function in health and disease using tools that are not often available within individual laboratories. The NCBC provides equipment, facilities, and services to aid investigators in performing behavioral assays of motor and sensory function, learning and memory, anxiety-like behaviors, social interaction, and sleep. The NCBC also provides imaging equipment and services for investigating the neural substrates of these behaviors, including multiphoton and lightsheet microscopy. The NCBC can either perform experiments for investigators or train laboratory personnel to perform the experiments in the facility.

The Iowa Neurobank (*Directors, Drs. Aislinn Williams, MD PhD, Marco Hefti, MD and Queena Lin, PhD*)

With high clinical volunteerism at Iowa, the Iowa NeuroBank Initiative builds on the existing collection of biospecimens to provide a core infrastructure that facilitates cellular and molecular neuroscience research that utilizes human biospecimens and patient-specific cellular models. The Iowa NeuroBank core facility will collect and manage samples of cerebrospinal fluid, blood, and postmortem brain tissues, and will integrate this with clinical records, macroscopic and microscopic imaging, and associated big data from each patient with brain disorders and matched control subjects seen at the UI Hospitals & Clinics. The Iowa NeuroBank will also generate, deposit, and distribute fibroblasts from human postmortem skin to provide patient-specific cellular models for the UI neuroscience community. Furthermore, to support collaboration and innovations in the field of human postmortem brain and stem cell research, the Iowa NeuroBank core facility will help researchers use highly sophisticated and precise technologies to facilitate *in situ* multi-omic analysis at the single cell level.

The Cardiovascular Research Center (*Director, Dr. Barry London, MD, PhD*)

Established in 1975 by the Dean of the College of Medicine under the direction of Dr. Howard Dittrich, the Cardiovascular Research Center aims to: 1) combine the cardiovascular programs of the College of Medicine

into a more cohesive unit that optimally utilizes its cardiovascular resources; 2) intensify, expand, and integrate basic and clinical research programs in areas related to cardiovascular research; and 3) evaluate the effectiveness of new measures for the prevention, diagnosis, and treatment of cardiovascular disease. The 18,000 square-foot facility that houses the Cardiovascular Research Center consists of a fifth- and sixth-floor addition to the Medical Research Center Building, which is approximately the geographic center of the complex that encompasses the UI Hospitals, Medical Laboratories Building, Eckstein Medical Research Building and Bowen Science Building. The fifth and sixth floors house investigator research laboratories, core research laboratories, administrative offices, and seminar rooms, as well as the cardiovascular library and the learning resource unit. Unique and attractive features of the Cardiovascular Research Center programs at UI are the close working relationships and cooperation among members of the basic science departments and the clinical departments, particularly the departments of Medicine, Neurology, Pediatrics and Surgery. Another element that has been key to the success of this Cardiovascular Research Center is the availability of a critical mass of full-time, tenured basic scientists, and clinical investigators at UI. This represents a major commitment of UI and state resources to cardiovascular programs, and contributes substantially to their stability and success.

Iowa Institute of Human Genetics (*Director, Dr. Richard Smith, MD, PhD*)

The Iowa Institute of Human Genetics (IIHG) integrates state-wide activities in human genetics to promote clinical care, research, and education focused on the medical and scientific significance of variation in the human genome. It has made important progress in multiple areas. For example, its Research Division has developed two targeted disease panels, a research exome program, and a bioinformatics pipeline for both clinical and research use. The pipeline is currently being expanded to increase its functionality by including haplotype reconstruction. As genomic data are generated, robust phenome-genome integration protocols are being developed to improve the mining of genomic data and the evaluation of identified variants for possible phenotypic relevance. All of these efforts require focused educational outreach – for healthcare providers, patients, and the general public. For healthcare providers the institute offers the Clinician-identified Exome Analysis for Rare Diseases (EARD) program, an annual bioinformatics short course, the IIHG seminar series, and a pilot grant program that supports human genetic research. For patients and the general public, it has developed a number of educational brochures and offers mini-medical school lectures and career days in human genetics. Undergraduates can participate in the IIHG summer internship program in genetic counseling and bioinformatics, and in the summer course in human genetics. The theme of innovation is integral to all IIHG activities, which ensure that and it reaches an international constituency. As a resource, the IIHG is open to all faculty, trainees, and staff in the 11 colleges at UI, as well as to their counterparts at Iowa State University and the University of Northern Iowa.

Iowa Institute for Biomedical Imaging (*Director, Dr. Colin Derdeyn, MD*)

The Iowa Institute for Biomedical Imaging (IIBI) is located in the Pappajohn Biomedical Discovery Building (PBDB) that was completed in 2014. The IIBI space in this new building encompasses 30,897 square feet devoted to human, large, and small animal imaging, image analysis, computational support, visualization, and biostatistical support. The IIBI space within PBDB has one floor for small animal imaging (5,544 sq. ft.) with 10 scanner rooms (including Optical/Bioluminescence, Micro PET/SPECT/CT, 7T micro MR scanner, High Resolution X-ray CT, and small animal ultrasound scanner), behavioral rooms, as well as research staff office space. Animal housing is located adjacent to the imaging equipment with more than 100,000 square feet of animal vivarium space, animal preparation rooms, and animal surgical suites. A second floor has 20,081 sq. ft. devoted to human and large animal imaging for translational research, with 5 large scanner bays, a cardiovascular imaging suite, a virtual/augmented reality visualization suite, subject preparation rooms, meeting rooms, and student/postdoc office cubicles. Research faculty/staff offices (2,627 square feet) are adjacent to the human imaging equipment. Human imaging equipment in IIBI includes research-dedicated 3T MRI (GE Premier), 7T MRI (GE MR950), CT, (Siemens Somatom Force), PET/CT (GE Discovery) scanner. The MR Research Facility offers pilot funding to support the acquisition of data for grant applications. Investigators may apply for 10 hours of scanner time to collect data needed to show preliminary data for grant

applications. This pilot mechanism has been used to acquire data to support numerous federal and private foundation grant applications.

Center for Bioinformatics and Computational Biology (*Director, Dr. Thomas Casavant, PhD*)

The Center for Bioinformatics and Computational Biology (CBCB) is a multidisciplinary research enterprise dedicated to integrative research involving biomedicine, engineering, basic life sciences, computational science, translational medicine, mathematics, and statistics. Founded jointly by the colleges of Medicine and Engineering in 2002, the CBCB has members from seven colleges, representing more than 20 departments. Students working on graduate degrees represent a wide variety of disciplines and interdisciplinary programs. The core of the CBCB facilities is in the Seamans Center for the Engineering Arts and Sciences, but faculty members and students are housed in departments throughout campus. Over the past 15 years, research in this growing field at the UI has led to significant contributions to large-scale genome and transcriptome sequencing, gene-mutation discovery, and the development of numerous computational and analytical methods for analyzing genetic and molecular biology systems.

Belin-Blank Center, College of Education (Director, Dr. Susan Assouline, PhD)

The Belin-Blank Center (B-BC) is located on two floors of the Blank Honors Center on the UI campus. Led by Director Susan Assouline, research and evaluation are central to the B-BC comprehensive programming, and it is one of the only gifted/talented education institutes in the nation with a clinical operation devoted specifically to the needs of high-ability students. Since 1988, the B-BC has conducted major research programs that address the academic and social-emotional needs of high-potential students, their families, and their teachers. Most recently, the B-BC has collaborated with investigators at the Iowa Neuroscience Institute (INI; Drs. Abel, Michaelson, and Nickl-Jockschat) to undertake a genetic and neuroimaging study of "twice-exceptionality" (2e), i.e., those gifted students who also have a developmental disability such as autism. This collaboration has successfully obtained funding from the Simons Foundation, and has digitized the extensive clinical records and psychoeducational data on 1,300 B-BC clients, many of whom qualify as 2e. More than 50 of these 2e individuals and families have already been recruited by Dr. Michaelson into the Simons Foundation Powering Autism Research (SPARK), and pilot neuroimaging studies of 2e using the 7T MR scanner have commenced. The B-BC houses administrative offices, classrooms, and an Assessment and Counseling Clinic (ACC). Staff includes 14 administrators, 1 post-doctoral fellow, 2 research associates, 9 graduate assistants, 4 undergraduate assistants, and 4 secretaries. The ACC is comprised of three state-of-the-art assessment and observation rooms and employs two licensed psychologists and one certified school psychologist. The Belin Family Research Library contains an extensive collection of materials specific to gifted education, academic acceleration, autism, and twice-exceptionality.

Iowa Testing Programs

For over 75 years, Iowa Testing Programs has served assessment needs in Iowa and across the country by developing high-quality instruments and working with schools to promote valid use of results. Its faculty and staff develop and validate standardized educational tests, such as the widely used Iowa Statewide Assessment of Student Progress and the Iowa Assessments, for use in elementary and secondary schools, as well as other assessment tools to support instruction and learning. Iowa Testing Programs also conducts research studies in educational measurement and evaluation, publishes the results of these studies, sponsors lectures and symposia, provides consulting and in-service training to educators and school systems, and provides training experience for graduate students in educational measurement and evaluation. Iowa Testing Programs is located in Lindquist Center, which houses the UI College of Education.

OTHER RELEVANT UI COLLEGES AND DEPARTMENTS

Department of Pediatrics (*Interim Chair, Eva Tsalikian, MD*)

The Department of Pediatrics has a long, distinguished history of excellence in scientific discovery and a strong tradition of pediatric research programs led by physician scientists. The department cultivates a culture that values, respects, and supports curiosity and discovery and has received national recognition for its research success and strong record of extramural funding and scholarly productivity. With more than \$12 million in funding, the department is committed to the importance of basic and applied research to understand childhood diseases and to develop and advance therapies for our patients. The vision of the new department head is to strengthen the department's mentoring program and grants management infrastructure. Advances in genetics, epidemiology, quantitative analysis, and developmental biology have made it possible to identify genes involved in traits important in pediatric disorders, birth defects, and prematurity. Researchers in the department are known nationally and internationally for their work in genetic and environmental contributors to pediatric disease. This leads to a better understanding of the origins of pediatric diseases with the goal of healthier children and mothers. Other research strengths include developing groundbreaking new treatments for asthma and cystic fibrosis; anemia and transfusion of preterm infants; prevention, intervention, and treatment of diabetes in children; breastfeeding promotion and support; epilepsy; genetic aspects of neuromuscular disorders; fetal programming of cardiovascular disease; inflammatory bowel disease; feeding disorders; and disruptive behaviors. The UI Department of Pediatrics is consistently highly ranked among all medical college departments in NIH research funding for pediatric diseases. Pediatric laboratory investigation emphasizes cellular and molecular biology, developmental biology, applied genetics and genomics, animal models of human disease, and translational research. Studies in these areas emphasize a multidisciplinary team approach. The collaborative research environment provides an outstanding setting for training the next generation of scientists with research interests focusing on problems that affect children's health.

Department of Obstetrics and Gynecology (*Chair, Kimberley Leslie, MD*)

The UI Department of Obstetrics and Gynecology was founded in 1870 and is a nationally recognized leader in women's health care and research, currently ranked 19th by US News & World Report. The department offers patients a range of basic and specialized services, including normal and high-risk pregnancy care, infertility options, urogynecology services, and gynecologic cancer treatments. The department is responsible for the care of all obstetric and gynecologic patients at UI Hospitals and Clinics (UIHC). In addition to patient care, the department is noted for its strong educational programs for medical students, residents, fellows, and practicing physicians. Basic and clinical research in reproductive medicine is an additional important departmental activity.

Dr. Kimberley Leslie serves as the chair of the Department of Obstetrics and Gynecology. She oversees a department of 250 members including 51 primary faculty members, 12 clinical and postdoctoral fellows, and 20 residents. There are five divisions within the department including the Generalist Division, Maternal Fetal Medicine, Reproductive Endocrinology and Infertility (REI), Urogynecology, and the Reproductive Sciences Research Division. The Reproductive Sciences Research Division includes six full-time Research Faculty and 10 faculty members with joint appointments. It is led by Dr. Donna Santillan and Dr. Eric Devor. This Division has secured funding from the National Institutes of Health, American Heart Association, American Cancer Society, and numerous other foundations.

In addition, the Department of Obstetrics and Gynecology supports the highly productive Women's Health Tissue Repository. This includes biobanks dedicated to Reproductive Endocrinology and Infertility (REI), Maternal-Fetal, Gynecologic Malignancy, Well Women, and Paternal sample and clinical collections. Because of the longitudinal sample collection from patients being seen in its clinics and significant clinical annotations, the department is able to advance maternal and fetal health research much more quickly than would be otherwise possible.

For biobanking efforts, the department draws from its large clinical population. The Department of Obstetrics & Gynecology sees over 65,000 clinical visits per year, performs over 1,600 surgeries and 2,600 deliveries, more than 50% of which are high risk cases. As the only academic medical center in the state of Iowa, the most challenging cases are often referred to this department. This reaffirms its position as the leader in women's healthcare and supports our research mission.

The UI, in collaboration with the Iowa Department of Public Health (IDPH), recently received a \$10 million grant from the Health Resources and Services Administration (HRSA) to reduce maternal mortality and severe morbidity in the state through data collection and analysis, workforce development, telehealth, and research initiatives to determine best practices.

Women's Health Tissue Repository

Women's Health Tissue Repository: The Department of Obstetrics and Gynecology at the UI Hospitals and Clinics (UIHC) began its biobanking initiative over 30 years ago with the Gynecologic Malignancy Bank. To fully explore all of the stages of a woman's life, the tissue repository has been expanded to include three additional banks: Reproductive Endocrinology and Infertility (REI), Maternal Fetal, and Well Women Bank. Additionally, male samples are obtained from the fathers through the Paternal Contributions to Children's Health (PATCH) biorepository. Each bank has IRB approval and falls under the infrastructure of the umbrella "Women's Health Tissue Repository." This infrastructure provides rigor in patient consent, sample handling and processing, and comprehensive coverage of clinical annotations of samples from electronic medical records. The goal of the Women's Health Tissue Repository (WHTR), led by Dr. M. Santillan, is to collect, bank, characterize, and distribute high quality human biological specimens related to the needs of investigators within the department and among collaborators. In addition to IRB approvals, each individual repository has IRB approval and a unique consent form to best address the issues related to each patient population. Participants in this biorepository reflect the population demographics of Iowa. The average pre-pregnancy body mass index is approximately 30. Logistically, having a centralized process within the department has not only supported standardized processes, but has also allowed for focused recruitment of patient populations with an enhanced understanding of the clinical flow to patient visits, standard of care samples, and engagement of faculty, staff, and learners in the collection and usage of samples. Thus, this model represents a hybrid of a large centralized biobank and a focused recruitment effort.

The primary strength of the Women's Health Tissue Repository is its excellent fidelity of sample handling and processing. This occurs because an extra tube of blood is collected solely for research use at the time of collection of clinically-indicated samples and all research samples are processed using a standard operating protocol to ensure that all samples are handled in an identical fashion. While collecting leftover clinical samples would cost less in terms of phlebotomists and sample collection supplies, there would be significant differences in how samples were collected, handled, and time to final storage that would impair the ability to be confident in experimental results. Further, we have high-resolution clinical information that correlates with all samples. This information makes these samples unique and extremely valuable for translational research. To extend the usability of all samples, each sample is aliquoted prior to storage to prevent multiple freeze-thaw cycles and to allow multiple investigators access to the same samples. Samples are stored and archived so that they will be of maximal use in the future for many different experiments. For example, maternal and cord blood cells are stored to be viable when thawed. This enables the maximal use of samples obtained at each collection and the ability to have paired samples of plasma and cells. Placenta samples are kept in an RNA stabilization solution (RNA_{later} from Ambion, Life Technologies Carlsbad, CA) as well as in liquid nitrogen to allow them to be used for RNA, DNA, and protein extraction. Further, having these samples linked to many elements in the electronic health record, will allow researchers to better answer very specific questions in women's health, such as studying the effect of a specific medication on protein modification. The WHTR is an incredibly powerful research tool that has stimulated many projects and allows us to explore genetic factors, environmental factors, health risk factors, and other variables in relation to the outcomes of care throughout the lifespan.

Iowa Maternal Fetal Tissue Bank

The Maternal Fetal Tissue Bank (MFTB), an arm of the Women's Health Tissue Repository has been enrolling pregnant women and their children since March 2010 to collect biomaterials and clinical data to enhance knowledge of pregnancy and its effects on maternal and child health. The MFTB collects maternal blood and urine, cord blood, and placental tissue as well as the information about the long-term health of the mother and child. Samples obtained from these initial participants has enabled the development of new technologies including generating patents for tests to predict women at risk of adverse pregnancy outcomes and the sequencing of the fetal genome from maternal plasma. Because women are enrolled prospectively without

regard to their current health state, samples can be collected before diseases even become clinically evident. Since 2010, MFTB has enrolled 4000 women and their children. In 2013, the Paternal Contributions to Children's Health (PATCH) study was started to collect samples and data from fathers of MFTB-enrolled pregnancies. There are currently 283 fathers enrolled that have a donated a blood sample and medical record information. These samples will be the source of samples for pregnant patients with preeclampsia and controls.

Department of Psychiatry (*Chair, Peg Nopoulos, MD*)

The UIHC Department of Psychiatry includes some of the world's most distinguished researchers who conduct cutting-edge research in the cause and treatment of psychiatric disorders. The department combines a high level of clinical competence with excellence in research and provides national and international leadership in the areas of epidemiology, genetics, epigenetics, neuropsychiatry, neuroimaging, medical psychiatry, mood disorders and schizophrenia. The Adult and Child Psychiatric Outpatient facilities at the UIHC comprise nineteen offices for patient interviews, two conference/group rooms, one medical exam room, one seclusion room, and clerical, administrative and reception, totaling approximately 6,000 square feet. The Department of Psychiatry's health care team includes psychiatrists, psychologists, physician assistants, social workers, nurses, and educators. The clinical staff members in the Department of Psychiatry are kept apprised of ongoing research studies and provide referrals to potential research participants on a continuous basis.

The Department of Psychiatry, in conjunction with Research Services, engages in a tier 3 backup of all imaging computer data. Research Services storage offerings comprise installations of storage resources located in three geographically distinct facilities. Each of these facilities offers redundant power and cooling as well as secured access utilizing biometric and proximity token systems. All of these facilities provide monitoring of cooling, power, and systems health, as well as multiple levels of keyed and biometric security and camera monitoring of access. All access to data uses centralized authorization and authentication mechanisms that comply with UI password aging and complexity requirements.

With one petabyte (PB) of research storage, data storage offerings housed in these locations provide multiple redundant hardware and software protection, in addition to the ability to seamlessly replicate data between these installations and provide quick recovery in the event of failure. One of these sites is the Research Services-managed Information Technology Facility (ITF). The ITF is an off-site energy-efficient data center that provides a safe and secure location for the vital IT infrastructure of the UI. Construction for this facility was strongly focused on environmental design and was completed in late 2011.

In addition to collaborative efforts with Research Services, the Department of Psychiatry also has a renovated server room, which provides space to house five standard 42U racks of computing equipment, and contains a dedicated 8-ton cooling system, four high voltage circuits, and dedicated environmental monitoring systems to insure proper environmental control. This facility provides the Iowa Neuroimaging Consortium (INC) with data center space that is very difficult to obtain in most campus environments and will facilitate the growth of the center.

Dr. Aaron Boes is the director of the Center for Noninvasive Brain Stimulation. This center includes an integrated clinical and translational research program. The center is supported by the resources and facilities in the Carver College of Medicine Department of Psychiatry and the Iowa Neuroscience Institute (INI). It is a state-of-the-art facility for translational research for noninvasive neuromodulation and includes transcranial magnetic stimulation (TMS) and transcranial current stimulation equipment. There are two locations dedicated to noninvasive neuromodulation research: the UI Hospitals and Clinics General Hospital (W264 and W271) and the Pappajohn Biomedical Discovery Building (PBDB) directly adjacent to the MRI Research Facility. Two full-time employees maintain the equipment and provide technical expertise for research studies. The noninvasive neuromodulation research program is closely aligned with the TMS Clinical Program, which is directed by Dr. Boes. The program is located in W240 General Hospital, immediately adjacent to the research program, and members include four psychiatrists and two fulltime staff members. The TMS Clinical Program offers 7–15 TMS treatment sessions per day, with two rooms.

Neuromodulation Equipment: The TMS program has a: 1) MRI-compatible research transcranial magnetic stimulation system with MagPro X100 Stimulator, MRI-B91 Air Cooled and Cooled-B65 coil with Localite Neuro Navigation System, 2) MagVenture MagPro X100 Stimulator with Cooled-B65 Coil and Motor Evoked Potentials Module, 3) Brainsight Neuronavigation Frameless Stereotaxy Equipment from Rogue, 4) Nexstim 5.0 Neuronavigation TMS System, 5) Neuroelectronics StarStim 20 Transcranial Electrical Stimulation System, and 6) a BrainVision TMS-compatible high density EEG system.

Department of Psychological and Brain Sciences, *College of Liberal Arts and Sciences, (Chair, Mark Blumberg, PhD)*

The Department of Psychological and Brain Sciences is at the forefront of 21st century psychological science in the classroom and the laboratory. Undergraduate and graduate students alike join with the faculty in the pursuit of leading-edge research designed to unlock the human mind and brain. In addition, the Psychology program is ranked #30 by *U.S. News & World Report*.

The Department of Psychological and Brain Sciences has a continuous wave NIRS device (CW-NIRS). The system is a 24-channel TechEN CW6 portable system (12 sources and 24 detectors), consisting of a CW instrument, computer, software, and accessories for laser sources and detector receivers. The laser source wavelengths are at 690 nm and 830 nm. The CW6 includes a data acquisition computer; control software for CW6; installed HOMER software for image reconstruction; optical fiber bundles; adult, child, and infant-sized caps; auxiliary inputs (4) to record other physiological input signals; and an optical power meter.

A machine shop, an electronics shop, and a computer assistance facility (with hardware and software specialists) are located in Spence Laboratories of Psychology and are available for use by faculty members, research associates, and students. Experienced personnel staff the facilities and assistance is free for all research projects. A staff member manages the database of birth records for the Iowa City area and the Participant Registry for the Psychology Research Laboratories at the UI, which helps with ease of participant recruitment.

Department of Biostatistics, *College of Public Health, (Head, Joseph Cavanaugh, PhD)*

This department has faculty and staff offices in the College of Public Health Building (CPHB) and the Clinical Trials Statistical and Data Management Center (CTSDMC). The CTSDMC, led by Dr. Christopher Coffey, is housed in the University Capitol Center (UCC) just across the Iowa River. The center was formed in 1989 to provide statistical and data management support for multicenter clinical trials, and has been extraordinarily successful in collaborating with researchers at the UI and at more than 100 other academic institutions, nationally and internationally. The center consists of a team of nine biostatisticians, five data managers, three Information Technology and Development Specialists, seven Protocol Coordinators/Monitors and a Quality Management and Assurance Specialist. The Center for Public Health Statistics is close to the CPHB in the Westlawn Building.

The Department of Biostatistics includes fourteen primary full-time faculty biostatisticians, ten secondary faculty, four adjunct faculty, and three emeritus faculty members. The methodologic expertise of the faculty includes: Bayesian statistics, clinical trials, linear models, time series analysis, model selection criteria, quality control, design of sample surveys, experiment design, survival analysis, nonparametric statistics, multivariate analysis, longitudinal data analysis, spatial statistics, missing data, data mining, health information systems, and categorical data analysis. The faculty are actively involved in statistical research, consultation, and collaboration with other researchers in: cardiovascular studies, neurologic disorders, diabetes research, transplant studies, cancer epidemiology, injury epidemiology and injury prevention, mental health epidemiology, cancer research, environmental modeling, nephrology, agricultural medicine, aging studies, HIV research, and health care delivery, among others. Each year the department engages in approximately 1,000 consultations ranging from brief discussions to long-term involvement with ongoing studies. Staff resources include master's degree level statisticians, computer professionals, and administrative support personnel.

The department has approximately 19 MS students and 22 PhD students. Most students serve as part-time research assistants or teaching assistants. The department has a Biostatistics Computing Laboratory, operating a Linux network for use by the graduate students and faculty, as well as access to the collegiate computing laboratory and resources that primarily operate Microsoft Windows. Faculty in the department have served as principal investigators on grants and contracts from the National Institutes of Health, National Science Foundation, National Security Agency, and the Iowa Department of Public Health. Biostatistics faculty collaborate with investigators in other departments in the College of Public Health and numerous investigators at the UI.

Biostatistics Consulting Center.

The Biostatistics Consulting Center is a unit within the Biostatistics Department of the College of Public Health. The unit was established to provide biostatistical consulting to the Carver College of Medicine (CCOM), and continues to offer expert statistical consulting for the CCOM researchers, as well as other health science researchers at the UI Colleges of Dentistry, Nursing, Pharmacy and Liberal Arts and Sciences. Full-time and student consultants from the Biostatistics Consulting Center work with investigators during all phases of health science research: proposal development, study design, data form or questionnaire development, data entry, data management, statistical analysis, and report preparation. The center is actively involved in research projects ranging from brief consultations to long-term collaborative research. Departmental faculty members are available as consultants to center staff and to all faculty, staff, and students of the health science colleges should the need arise.

The Consulting Center assists researchers with all phases of basic science, clinical, and epidemiologic research. From an investigator's objectives, questions, and hypotheses, they can:

- assist with grant proposal development,
- assist in study design,
- develop efficient data management strategies,
- perform appropriate statistical analysis,
- assist in writing reports for scientific publication,
- provide data entry service and consulting with forms design.

Health science researchers may use Biostatistics Consulting Center staff as advisors during the planning of their projects and preparation of grant proposals. With the center's help, researchers can develop survey or experimental designs involving appropriate numbers of cases to achieve desired statistical power.

The UI Information and Technology Services (*Senior Director, Michael Noel*)

The UI High Performance Computing (HPC) group works to provide high-performance and high-throughput computing resources to members of the campus community. The High Performance Computing group supports the Argon cluster and is a collaborative initiative currently led by Information Technology Services.

The HPC resources are managed by 11 specialists who provide support and consultation services for the computer clusters. The Argon HPC cluster is the primary central HPC resource. The system contains more than 612 compute nodes with over 15,000 processor cores and 94 GPU accelerators. The system contains high-speed internal networks-based Omni-Path and is connected to the campus via multiple 10 Gb ethernet connections.