Rush Research Resources and Facilities

This document includes information for prospective research participants, sponsors, and investigators - including hyperlinks to many online resources. Investigators and staff are encouraged to select descriptions that are relevant to their needs and edit the content according to format and length constraints.

Office of the Vice President and Vice Provost for Research

Rush is committed to fostering centers of excellence that combine clinical, basic and population science to study areas of importance to the community. A comprehensive Strategic Plan for Research and several programs have been created to support and encourage Rush investigators involved in more than 1,600 research studies - including clinical trials of new medical and surgical therapies. The office is under the direction of Joshua J. Jacobs, MD, Vice President for Research - RUMC, Vice Provost for Research - Rush University, and the Institutional Responsible Official. The Office helps establish and support the mission of Research at Rush which is dedicated to the pursuit of outstanding biomedical and sociobehavioral research to advance knowledge and optimize patient care.

Office of Research Affairs

At Rush, the research contributions of faculty generate meaningful publications, values-driven care, lifesaving drugs and leading-edge innovations ranging from omics-based discoveries to the next breakthrough drug or device. Continuously, our research teams progress toward measured, peer-affirmed outcomes that improve quality of life and our understanding of the human condition.

The Office of Research Affairs (ORA) exists to partner with faculty and staff as they seek funding, propose clinical studies, establish collaborations, steward funds, submit grants, negotiate industry contracts, and secure patents and licensing agreements. The ORA is headed by Rush's Chief Research Administrator, Thomas J. Champagne, MBA, and has organizational reporting responsibilities to the Office of the Provost (Vice President & Vice Provost for Research), and the Office of Medical Affairs (Vice President & Principal Business Officer) at Rush.

The ORA is comprised of six distinct service divisions - intent on delivering high quality service, support, and counsel to the Rush research enterprise, faculty, staff, and students. The Divisions of the ORA are:

1. **Clinical Research Administration**
2. **Innovation & Technology Transfer**
3. **Institutional Animal Care and Use**
4. **Research Regulatory Operations**
5. **Sponsored Programs Administration**
6. **Technologies Supporting Research**

As Rush continues to invest more in the success of our faculty researchers, we are increasing our sponsored award base, adding research participants, investing in technologies, establishing new

core facilities, strengthening research protections, and continuing to invest in state-of-the-art equipment and facilities. Specific details for these Divisions follow below.

1. Division of Clinical Research Administration

The division of clinical research administration within the Office of Research Affairs facilitates the operational and financial aspects of clinical research across Rush University, including the clinical and translational science award in partnership with the University of Chicago through the Institute for Translational Medicine Chicago ITM and the cancer clinical trials office.

The division sets the strategic vision for clinical research administration and provides leadership to ensure the enterprise has the following:

- Well-funded leading-edge research in key therapeutic areas
- Efficient study start-up that sets the pace for academic medical centers in Chicagoland
- Effective execution of clinical research-related activities
- Preferred status with key industry sponsors

Through the implementation of Chicago ITM in early 2018, this division has the support of the Trial Recruitment and Innovation Office (TRIO) to improve the time it takes to initiate new clinical trials and to mitigate roadblocks to subject recruitment. In addition, Chicago ITM is a key partner with Northwestern University in the 3rd Annual Enhancing Quality in Translational Research (EQuaTR) Workforce conference in May 2018.

This division supports research teams at Rush University in the following ways:

- Negotiation of research agreements
    - Confidential disclosure agreements
    - Clinical trial agreements (including sub-awards)
    - Independent contractor agreements for research
- Clinical research core support
    - Training and Education, e.g., clinical research new hires, continuing education
    - Assistance with operational activities from study start-up to study close-out
    - Clinical Research Regulatory Coordinator support*
    - Clinical Research Nursing support*
    - Clinical Research Coordinator support*
    - Synchronization (“sync”) process
- Clinical research finance support
    - Coverage analysis development
    - Medicare submissions for investigational devices
    - Budget development and negotiation*
    - Industry sponsor invoicing
- OnCore clinical trial management system (CTMS) support
    - Training and education on how to use the system
    - User / technical support

*These resources are limited but growing.

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OnCore CTMS Team

2. Division of Innovation & Technology Transfer

The Division of Innovation and Technology Transfer (I&TT or "IP Office") is responsible for managing the intellectual property assets generated by research and educational activities at Rush. The IP Office seeks to guide technologies through the various stages of the commercialization process by providing services that include evaluation, protection, marketing, and licensing of intellectual property.

The IP Office protects faculty interests while advancing discoveries toward commercial development. A high-performance team with a broad range of subject matter expertise provides a full suite of support services to ensure that Rush inventions reach their fullest potential. The IP Office assists Rush faculty by:

- evaluating research results and inventions for patentability and navigating it through the patenting process
- protecting intellectual property while protecting academic priorities, interests and values
- effectively transferring discoveries and inventions from the laboratory into commercial development
- helping form collaborations with industrial partners for new sources of research sponsorship
- monitoring research and license agreements to ensure the development and commercialization of your technologies
- helping with startup formations by facilitating access to the entrepreneurial ecosystem that includes mentoring, incubators and accelerators as well as investor network

The IP Office is passionate about its role at Rush and continues to endeavor to see Rush has a strong impact on the next generation of biomedical technologies that will improve patients' lives.

3. Division of Research Regulatory Operations

The ORA supports a Division of Research Regulatory Operations (RRO) that has primary responsibility for stewarding Rush's regulatory responsibilities as imposed by sponsors, other institutions, as well as community, local, and Federal government agencies. The Division has responsibility to oversee the administrative effectiveness and responsiveness of regulatory committees at Rush including, among others, the IRB, IACUC, DURC, Biosafety, and data safety monitoring activities. Monitoring general laboratory safety is also within the purview of the RRO division. Rush's Biological Safety Officer is a member of the RRO division staff. Additional details of the key RRO regulatory groups can be found below, throughout this document, and at the hyperlink above.

Biological Safety Program

Since 1997**,** Rush University Medical Center has operated an Institutional Biosafety Committee (IBC) to review all research activities involving recombinant or synthetic nucleic acids as required by the *NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules* (rev. 2016) and by university policy RA-IBC-001. This 11-member committee chaired by Amarjit Virdi, Ph.D. has cross-representation from the Institutional Animal Care and Use Committee (IACUC) and from the Dual-Use Research of Concern (DURC) and Biohazard (BHZD) Committees. Committee members include faculty from the departments of Microbial Pathogens and Immunity, Cell and Molecular Medicine, General Surgery, and the Divisions of Gastroenterology and Infectious Diseases. Other members include the Biological Safety Officer (BSO), representatives of hospital Infection Control and the Office of Research Compliance, as well as two community members who are unaffiliated with Rush. IBC business is conducted in standing monthly convened meetings. The Biological Safety Officer, Ed R. Blazek, Ph.D., SM (NRCM) pre-reviews applications to assist the investigator prior to official review by the full committee, reviews literature relevant to applications in service to the IBC, and schedules the agenda of the IBC. The IBC maintains a database of approved programs as well as an informative web site, and annually updates its registration with the NIH Office of Science Policy. A mandatory web-based Biosafety Training Program for investigators and their laboratory personnel, gene transfer clinical coordinators, and IBC members has been established. Investigators or their designees are trained in the shipping of dangerous materials by EHS. All approved programs are subject to a formal amendment process for all substantive changes, and clinical programs receive annual continuing review. All laboratories of IBC-approved programs are inspected initially and periodically by the BSO.

DURC and Biohazard Committees

Rush University Medical Center is in compliance with the *United States Governmental Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern.* This policy governs all research performed with any quantity of 14 specific pathogens and one toxin, requiring the *institutional* review of such research to determine whether a risk mitigation plan is needed to minimize the chance that the research will be misapplied. If the research meets these criteria, the risk mitigation plan must be approved and enforced. Under its approved institutional policy RA-DURCBHZD-001, Rush has established the required Institutional Review Entity (IRE) called the DURC Committee, and has named an Institutional Contact for Dual-Use Research (ICDUR, Brett Williams, M.D.), who also chairs the committee. The DURC Committee will convene quarterly to review new potential DURC research and do annual continuing review of previously-approved projects. The DURC Committee has determined that no current research at

Rush meets the DURC criteria to require approval of a risk mitigation plan. To oversee biological and/or biochemical hazards that do not meet the DURC criteria and also do *not* involve recombinant or synthetic nucleic acids and therefore do not require oversight by an Institutional Biosafety Committee (IBC) according to *The NIH Guidelines for Research Involving Recombinant and/or Synthetic Nucleic Acid Molecules (rev. 2016),* the same membership of the DURC Committee will constitute a Biohazard Committee. This committee will convene monthly, or as necessary, and will review and evaluate the safety of research projects that use human or animal pathogens, exempt quantities of Select Agents, the Parkinson's syndrome-inducing prodrug, 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP), nanoparticle preparations, and new, potentially biohazardous agents that may be developed.

Radiation Safety Program

Rush University Medical Center has a Radiation Safety Program under the direction of Radiation Safety Officer (RSO) Catherine Anderko. A broad-based Radiation Safety Committee (RSC), as required by the State of Illinois, is chaired by Mark Supanich, Ph.D. All routine clinical and research laboratory aspects of ionizing radiation use, such as dose monitoring, radiation protection, nuclear medicine hygiene, and radioactive waste disposal, are managed by the RSO under oversight by the RSC. The clinical and non-clinical use of ionizing radiation for research purposes is subject to review and approval by the RSC. The RSC is also responsible for overseeing all uses of radioactive material. All research studies using ionizing radiation for treatment, guidance or localization, screening, or treatment response assessment must be submitted for radiation safety review. If the use of ionizing radiation is determined to be consistent with the Standard of Care, no further review is necessary. If the use of ionizing radiation differs from the standard of care or presents unknown or increased radiation risks, a designee of the committee will review the protocol and informed consent document and provide model radiation risk consent language if required. Some protocols, such as new uses of radioactive materials may require full RSC review.

Laser Safety Program

Rush University Medical Center has a Laser Safety Program under the direction of Steven Edwards, Director, Occupation Safety, and Randall E. Johnson, Interim Laser Safety Officer (LSO), Clinical Engineering Services. The purpose of the program is provide clinical staff, researchers, students, patients, and visitors with a safe laser use environment by managing the selection, use, and maintenance of lasers and laser-containing systems at Rush University Medical Center and Rush University Medical Group. This program implements guidelines to ensure that no laser radiation in excess of the maximum permissible exposure (MPE) limit reaches the eye or skin of clinical staff, students, patients, and visitors. Additional guidelines ensure adequate protection against non-beam hazards that can be associated with the use of lasers: risk of electrical shock, explosions, fire, and exposure to harmful chemicals or biological hazards. The program also conducts relevant educational programs, performs work place inspections including those used for clinical procedures, and inspects and repairs laser equipment, documenting maintenance histories to satisfy applicable regulations. Program responsibilities are drawn from guidelines established by the American National Standard for the Safe Use of Lasers in Health Care Z-136.3-2011, and FDA CFR 1040.10. The Program complies with the Illinois Emergency Management Agency (IEMA) regulations for acquisition, registration, use, transfer, and disposal of class 3b and 4 lasers. A Laser Safety Committee, (LSC), as required by ANSI and IEMA is chaired by Steven Edwards. Its purpose is to advise on laser activity and enforcement of operational policies and procedures at Rush.

4. Division of Sponsored Programs Administration

The Division of Sponsored Programs Administration (SPA) provides assistance to faculty and staff in obtaining and managing sponsored awards that support research activities. SPA is charged with accepting grants and contracts for sponsored programs funded by federal and state agencies, foundations and other public agencies, and providing guidance to assure proper stewardship of funds that are received. In addition, SPA prepares and negotiates sub-awards for collaborative research.

The mission of SPA is to provide superior guidance and support to faculty, staff, and administration in the pursuit of funding and collaborations reviewing and approving proposals submitted to all sponsors, for interpreting, negotiating, and for research, education and outreach.

5. Division of Institutional Animal Care & Use – Comparative Research Center

Rush is committed to excellence in patient care, education and research. In its commitment to excellence in these areas, the institution acknowledges the need for continued use of animals in teaching, research and testing, and the undeniable link of animal research to the advancement of biological and medical knowledge. Information and experience that are gained through the use of animals has improved, and will continue to improve, the quality and length of human and animal life.

Rush is committed to the judicious and humane care and use of animals in teaching, research and testing. The use of animals at Rush is a privilege granted through the Institutional Animal Care and Use Committee (IACUC), with moral, scientific and legal obligations for humane care and treatment of the animals.

Rush will comply with all applicable provisions of the Animal Welfare Act, other federal statutes and regulations relating to animals and any state statutes and regulations related to animals. As the institution receives federal funding and has an approved "Assurance of Compliance with Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals," all persons will strictly adhere to the provisions of the PHS policy and the Rush PHS assurance. As the PHS policy covers all vertebrate animals, the institution's policies and procedures will apply to all vertebrate animal use, regardless of the funding source. Rush is also guided by the "U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Teaching," detailed in the PHS policy. All animal care and use will follow the Guide for the Care and Use of Laboratory Animals (Guide). In situations where the regulations enforcing the Animal Welfare Act are specific and more restrictive than the PHS policy, these regulations will take precedence over the PHS policy.

The Comparative Research Center (CRC) is located in state-of-the art facilities in the RUMC, Cohn Building and occupies approximately 23,300 gross square feet. The Comparative Research Center is responsible for implementing the Rush Animal Care and Use Program and managing animal care facilities in accordance with the Guide. The Center's functions include procurement, care and maintenance of all animals used in research, teaching and testing, and the provision of professional advice to research and teaching staff.

Periodic assessment of the effectiveness of the CRC is provided at multiple levels by numerous sources including, but not limited to: semiannual program review and inspection of the facility by the Institutional Animal Care and Use Committee; annual performance reviews of CRC

personnel; annual unannounced inspections by a USDA Veterinary Medical Officer; triennial site visits by the AAALAC International Council on Accreditation; and annual reporting to the USDA, Office of Laboratory Animal Welfare (OLAW) and AAALAC.

6. Technologies Supporting Research

The ORA works closely with the Office of Information Services at Rush to support key research administration technologies including the Rush Research Portal, Faculty Profiles, Inter- and Intranets for Research, LINK, COI databases, GRANITE, e-IRB capabilities, interfaces with sponsor databases, and other network and infrastructure-related needs of faculty and staff. The key technology application within the ORA is the Rush Research Portal described below.

The Rush Research Portal (RRP) is a key methodology to manage many aspects of the clinical research and sponsored programs submission process. All new clinical research studies are submitted electronically through the RRP. IRB studies that were active prior to September 17, 2007 (legacy studies) have been uploaded into the system.

One of the many benefits of the RRP is its accessibility via the Internet, allowing a streamlined approach to the submission, review and approval of research projects, even if the necessary people are not physically here at Rush. The system will notify department approvers, IRB staff and/or other study staff as the project advances through the system. This process eliminates the need to submit 13 paper copies of studies to the IRB.

New components to the RRP are available. Coverage Analysis, Grants and Contracts can now be created and submitted through the RRP. This will allow an even more efficient process linking the IRB study, Coverage Analysis, Grants and Contracts in one central location. A Clinical Trials Participant Tracking (CTPT) module is currently being built and should be released in the near future.

To obtain a login ID for the RRP, all users are required to attend training. Training is available every Friday in the lower level of the Annex building at 11 a.m. Additionally, all users are required to complete their mandatory training prior to having their study reviewed by the IRB. The mandatory training is accessible through the Rush Leap OnLine system and CITI Program.

Office of Research Compliance (ORC)

The Office of Research Compliance (ORC) is under the direction of Stephanie C. Guzik, MBA, BSN, RN, CHRC. The Office of Research Compliance promotes a culture of compliance, research integrity and high quality research within the Rush community. We function within the Office of the Vice Provost and Vice President for Research. To promote this culture of compliance, we partner with the University, Corporate and Legal Offices.

Programmatic Elements

Oversight of the regulatory, ethical and compliance aspects of all preclinical and clinical research conducted at Rush is a complex, multidimensional undertaking. We advise and consult the research community on navigating regulatory complexities. Our mission is to support each operational area in its primary responsibility to ensure compliance. The following content areas are the focus of the Office of Research Compliance (ORC) program:

- Research Compliance education and training
- Responsible Conduct of Research (RCR)
- Human subject protections (biomedical and social/behavioral)
- Animal use protections
- Research privacy and security
- Regulatory compliance
- Assessments of scientific integrity
- Investigate non-compliance
- Conflicts of interest (individual and institutional)
- Research misconduct
- Questionable research practices
- Financial management associated with funded research
- Authorship best practices
- External Audit preparatory services

Core Functions

Compliance Oversight Mechanisms. The ORC incorporates the seven fundamental elements of an effective compliance program (issued by the Office of Inspector General (OIG)) through review and implementation of policies and procedures, conducting effective education and training, routine and for cause audits, establishing a hotline and responding promptly to detected offenses and undertaking corrective action. Directed audits are conducted in response to identified concerns to assess research compliance with federal, state, and local laws, as well as Rush policies.

- ***The Evaluation Quality Improvement Program (EQuIP)*** identifies areas of investigator /research team vulnerability regarding adherence to regulatory requirements, protocol, organization, and record keeping. This audit/review process highlights areas requiring education, and fosters enhanced communication between research administration and the research community. Data gathered during the EQuIP project provides ORC with an understanding of gaps in knowledge that can later be addressed through policy and training programs for the research community. Results of EQuIP, directed audits, and periodic compliance reviews are reported to the Chief Compliance Officer, the Vice President and Vice Provost for Research, and the Institutional Review Board (IRB) in cases involving human subjects research, and in certain instances, to the Office of Legal Affairs and/or the Audit Committee of the Board of Trustees.

- ***Research Conflict of Interests (COI).*** The Office of Research Compliance is responsible for the administrative collection, review and management of financial and other interests that have the potential to impact an individual's professional or the Institution's research responsibilities at RUMC. The goal of this program is to develop and maintain processes for identifying and managing external interests in conjunction with the Conflict of Individual and Institutional Interest in Research (COIIIR) Committee that has the potential to impact an individual's or the Institution's professional or research responsibilities.

- ***Research Misconduct.*** The Director of Research Compliance serves as the Research Integrity Officer (RIO) for RUMC and is responsible for receiving and processing all allegations of Research Misconduct. In addition reporting annually to DHHS's Office of Research Integrity about allegations and investigations of Research Misconduct. Research Misconduct means fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results. Reporting suspected research misconduct is a shared and serious responsibility of all members of the academic community. Any person who suspects research misconduct has an obligation to report the allegation to the RIO. Allegations are handled under

procedures described in RUMC's policy titled *Research Misconduct: Policy For Review and Reporting Allegations*. All reports are treated confidentially to the extent possible, and no adverse action will be taken, either directly or indirectly, against a person who makes such an allegation in good faith.

We strive to assist the research community in navigating the complex regulatory matrix in your research endeavors. Our experienced team members are available for consultation.

Contact us

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Research Core Facilities

All the scientific cores have pricing structures that are advantageous for Rush investigators and will therefore allow greater productivity per grant expenditure than comparable external facilities operated by neighboring universities or commercial laboratories. With rare exceptions, investigators can receive training to operate these facilities independently, thereby reducing the labor charges associated with larger projects.

1. MicroCT/Histology Core (MCTHC).
Micro-computed tomography (MicroCT, μCT) is a non-destructive, x-ray based technique used to construct three-dimensional images of objects with natural or contrast-enhanced radio-opacity. The laboratory has been used by investigators from Rush and extramural investigators from several universities across the U.S for *ex vivo* imaging of bone, cartilage, nerve, vascularity, and various biomaterials. There are two μCT scanners in the lab. The microCT40 (Scanco Model 40) has a nominal best resolution of 6 μm with a real resolution of ~9 μm (45-70 kVp); reconstructed image matrix of either 1024 x 1024 or 2048 x 2048; field of view up to 37 mm and maximum scan length of 7 cm. The microCT50 (Scanco Model 50) has a nominal best resolution of 0.5 μm with a real resolution of ~1 μm (45-90 kVp) and a maximum scan length of

16 cm and field of view of 48 mm. Reconstructed image sizes can be as large as 8190 x 8190. Both instruments have an open VMS operating system; complete imaging software for data acquisition, online/offline reconstruction, 3D visualization and animation, 2D and 3D trabecular bone histomorphometry, and a database for tracking specimen processing and archiving. Images can be exported in DICOM and TIFF formats and the morphometric data can be readily downloaded to Excel spreadsheets. The histology core provides support for preparing ground or thin sections from plastic-embedded, undecalcified bone specimens (often containing a metal implant) and paraffin embedded, decalcified specimens. Undecalcified samples are embedded in methylmethacrylate during a 4 week process and can be sectioned using an Isomet 5000 linear precision saw and ground to ~100 µm thickness and/or polished to a mirror finish using a Phoenix 400 grinder/polisher. Decalcified samples are processed in paraffin using a Leica TP1020 automatic processor and embedded using a Leica Arcadia H automatic paraffin embedder. Thin, undecalcified sections are cut to a specified thicknesses (approximately 6 µm) using a tungsten carbide blade on a Leica RM2255 microtome. Paraffin sections are cut using low profile disposable blades. A variety of histological stains are available for both undecalcified and decalcified sections. The lab also has the ability to perform histochemistry and immunohistochemistry. The MicroCT/Histology Core is facilitated by Rick Sumner, Ph.D., chair of the Department of Cell & Molecular Medicine.

2. Flow Cytometry Core (FCC).

Instrumentation: The Rush University Medical Center flow cytometry core facility currently operates four Becton-Dickinson instruments: one dual-laser FACSCalibur, one three-laser FACSCanto II, one three-laser BD-LSR II analyzer and one four-laser BD LSRFortessa. The FACSCalibur flow cytometer is an end user-operated instrument with two lasers, permitting measurement of four fluorescent and two light-scatter parameters. Trained users prepare and acquire/analyze their own samples using a Macintosh G4 computer and either CellQuest™ or FlowJo software. The FACSCanto II flow cytometer is an operator-assisted instrument with three lasers (405 nm, 488 nm, and 633 nm), permitting measurement of eight fluorescent and two light-scatter parameters. The LSR-II flow cytometer is a three-laser (405 nm, 488 nm, and 633 nm) instrument capable of measuring up to twelve parameters (10 fluorescent and 2 light-scatter), and is operator-assisted. The LSRFortessa flow cytometer is a four-laser (405 nm, 488 nm, 561 nm, and 640 nm) instrument capable of measuring up to eighteen parameters (16 fluorescent and 2 light-scatter), and is operator-assisted. Trained users bring prepared samples to the facility and are assisted on their acquisition/analyses using the PC-based FACS DiVa or analyses using Macintosh-based FlowJo software. Multiple analysis workstations are available for the purpose of post-acquisition analyses. These workstations offer both PC- and Macintosh-based analysis and are installed with software for both FlowJo and FACS DiVa software. The facility staff will train investigators in the use of data analysis software programs for the purpose of data reanalysis or graphics production.

Services

- Immunophenotyping
- Cell viability/apoptosis
- Intracellular protein staining
- Multiplex assays for detection of cytokine and chemokines
- Cell tracking and proliferation
- Cytotoxicity
- DNA or RNA analyses

The flow cytometry core was established in the Department of Microbial Pathogens and Immunity and is under the direction of Alan Landay, Ph.D.

3. Rush Proteomics Core (RPC)

The Rush Proteomics Core (RPC) offers a wide range of services for designing, conducting as well as analyzing researches related to proteomics. These services include the identification of proteins including antigens, profiling of serum and plasma proteins, detection of novel serum and tissue biomarkers indicative of diseases, analysis of post-translational modifications, characterization of protein-protein interactions, and identification of molecular pathways involved in health and disease. The RPC supports the research of both junior and senior investigators and assists clinical/translational researchers in conducting laboratory procedures.

RPC services include:

We offer consultations on experimental design, guidance on choosing the most appropriate platform for specific research objectives and data interpretation, training for self-service activities, performance of procedures as needed and post-experiment analysis. Specific services include the following:

- One- and two-dimensional gel electrophoresis and Western blot
- Computer-aided image capture and analysis
- Protein isolation and high-resolution protein analysis
- Extraction of proteins from formalin-fixed paraffin-embedded (FFPE) archived tissues for profiling of proteins for which no fresh sample is available
- Production and purification of recombinant proteins, using E. coli
- ELISA assay for biomarkers, hormones, proteins and lipids from many biological fluids, including dried blood spots
- Bioinformatics support, using analytic software for gels and Western blots
- Biomarker-discovery algorithms and protein-database searches
- RPC personnel also teach in several graduate-level courses to introduce basic proteomics methodology to students and young investigators.

The RPC facilitator is Dr. Animesh Barua, Ph.D. and the facility is managed by Seby Edassery M.S, a biotechnology and bioinformatics specialist with over 20 years' experience in molecular biology, proteomics and data analysis.

4. Rush microRNA and Gene Expression Core (RMGEC).

The microRNA and Gene Expression Core facilitates research on the determination of molecular pathogenesis and diagnosis of disease, development of disease-targeted drug and molecular monitoring of treatment efficacy.

RMGEC is equipped with Applied Biosystems' advanced quantitative PCR instruments, Thermo Fisher ViiA 7 and 7900HT Fast real-time PCR systems with 96- and 384-well capabilities, Bio-Rad MJ Research Dyad and PTC 200 PCR systems with multi-block thermals for routine PCR applications, ChemiDoc XRS with Quantity One software for gel imaging and quantitation, and NanoDrop technology for accurate measurement of quality and quantity for DNA and RNA.

The services provided by RMGEC covers all aspects of miRNA and gene expression analysis, from DNA/RNA/miRNA preparation, to microarrays, miRNA and gene profiling, functional annotation analysis, and validation studies. RMGEC will also do next generation sequencing and data analysis. It facilitates research at all levels, from clinical diagnostic studies to cutting-edge basic, discovery research. The RMGEC facilitator and staff provide consultations to help researchers, especially newcomers to genetics and molecular biology studies. The spectrum of support ranges from investigator training in operation and troubleshooting of the apparatus to experimental design/optimization. The RMGEC encourages collaborations with researchers, and will provide support to researchers during their grant application and help to enhance their miRNA and gene expression components of the grant proposals.

The RMGEC facilitator is Dr. Animesh Barua, Ph.D. and the facility is managed by Seby Edassery.

5. Rush Biomarker Development Core (RBDC)

The Rush University Biomarker Development Core provides a cost-effective and rapid means to evaluate protein biomarkers (such as cytokines, growth factors, and autoantibodies) in any biological specimen and for any size project, including large clinical trials. Examples of biological samples include: serum, plasma, synovial or cerebrospinal fluids, urine, tissue or cell lysates, and conditioned media. All evaluations can be performed with either absolute or relative quantitation, and will be performed using the Luminex xMAP immunobead platform by highly-experienced experts trained by the Luminex Corporation. This platform permits simultaneous quantification of up to 500 analytes from low microliter volumes of sample. Early disease detection and monitoring of disease progression and treatment response are principal applications. Commercial kits are available for a wide array of potential analytes by multiple partners of the Luminex Corporation. We also offer services for custom assay development for any analyte of interest that may not be currently available through commercial sources.
The director of the RBDC is Jeffrey A. Borgia, Ph.D. and the facility is managed by Cristina Fhied. For questions please contact Cristina Fhied 312-942-2210.

6. Rush University Biorepository Core

The Rush University Biorepository Core, or RUBC, is a new resource within the research core system designed to provide key infrastructure to support the accrual of biospecimens from individuals being evaluated or treated for a specific condition at Rush or one of our clinical partner institutions. The strategic accrual of these resources will provide Rush investigators with subject cohorts necessary to support specific translational biomedical research studies, as well as an opportunity to play leadership roles in the innovation of novel preventative, diagnostic and therapeutic approaches that will serve as the foundation by which we can offer the latest in individualized therapy to our patients.

Equipment capabilities. The RUBC is highly integrated with both the clinical trials office at Rush to support infrastructure for acquisition of informed patient consent and the Department of Pathology as an interface with the clinical specimen processing labs. Laboratory technicians and coordinators are responsible for guiding all patients through the process of enrollment and tracking their specimens through acquisition, processing, and long-term archiving. All specimens are catalogued using a LIMS system, which provides a platform for rapidly accessing

biospecimens for use or transfer to external long-term archiving facilities, including a freezer farm with both -80°C freezers and cryogenic LN_2 storage systems. Finally, the entire facility (including each individual component) are monitored 24/7 by our Checkpoint system, which alerts laboratory personnel immediately in the event of malfunction in any component of the cryopreservation facility. Sufficient backup cryopreservation units are available to accommodate any catastrophic instrument failure that may jeopardize specimen integrity.

Services offered. Investigators at Rush have been archiving biospecimens (surplus tumor/tissue from surgeries, serum, plasma, plasma buffy coat) to support its thoracic oncology research program since 2004. Standardized biobanking protocols consistent with recommendations provided in the *NCI Best Practices for Biospecimen Resources* (published by the Office of Biorepositories and Biospecimen Research at the National Cancer Institute) have been employed from the beginning. The leadership of the RUBC regularly attends scientific meetings and seminars focused on biobanking sciences to ensure that the latest advances are integrated into its standard practices.

Project initiation. The RUBC invites all groups at Rush interested in biobanking specimens for either current or planned research projects to come in for a no-cost preliminary consultation. In this meeting, we will identify the key components to form a new collection effort, including the types of biospecimens desired, optimal protocols for processing and archiving biospecimens based on anticipated analyses, the scope of collection, and relevant regulatory issues. A quote is developed from this meeting that will permit the collection effort to commence in a timely manner and will include any additional infrastructure that may be needed to support patient recruitment, biospecimen collection, annotation, processing, and long-term cryopreservation. Investigators at Rush can also partner with the RUBC to access biospecimens already collected as part of our ongoing initiatives. We will provide guidance to help these investigators determine the suitability of existing collections of patient materials for their studies. Please contact us concerning this process and the anticipated cost structure for accessing the desired resource.

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7. IM Research and Drug Discovery Imaging Core

The IM research CORE facilities consist of multiple state-of-the-art imaging, liquid handling, high-throughput, and other analytical equipment. The list of equipment includes High-Content Screening (HCS) Systems, Electron Microscopy (TEM/SEM), Confocal Microscopy, Live-Cell Imaging, and Flow Cytometry. The facilities housing the equipment were entirely renovated in 2013 and early 2014 as part of Dr. Jochen Reiser and Dr. Vineet Gupta's research laboratories and occupy space on the 1st and 7th floors of the Cohn building.

7A. High-Content Screening (HCS) Systems: The Core oversees the operation of a Perkin Elmer Opera HCS System, which offers the ultimate in high throughput, speed and resolution – making it the ideal solution for flexible, scalable assay development and robust screening. The Opera system utilizes Acapella high content imaging and analysis software and offers solutions for apoptosis, calcium flux, cell cycle, cell differentiation, cell migration, cell proliferation, cell shape changes, cytoskeletal rearrangement, cytotoxicity, fluorescence in situ hybridization

(FISH), lipid droplet analysis, neurite outgrowth, protein expression, receptor activation, RNAi screening, signaling pathway, and transcription factor analysis . The HCS facility also has a Perkin Elmer JANUS automated workstation - a liquid handling robot that provides real-time and future adaptability for augmented throughput, plate capacity and dynamic volume range. It includes a gripper 'pick and place' robotic arm for automatic 'on the fly' switching of heads for optimal precision pipetting and performance. JANUS NanoHead dispense heads, with proprietary Modular Dispense Technology (MDT) enhance assay miniaturization with 384-tip processing down to 50 nL with C.V.s less than 13%. Also in the HCS facility, a BioTek plate washer is available for washing cells in 96- and 384-well plates.

7B. Electron Microscopy: The Core Facility can provide researchers access to a scanning electron microscope with transmission electron microscopy (TEM) capabilities. Services include critical point drying and gold coating of EM samples. The Zeiss Sigma HDVP Electron Microscope is a high definition imaging system capable of producing ultra high resolution images with a resolution of up to 1nm. This scope features both high vacuum and variable pressure modes, and is equipped with five different detectors including: a secondary electron detector, a back scatter detector, an in-lens detector, a variable pressure secondary electron detector, and a scanning transmission electron microscopy (STEM) detector to image TEM tissue sections. This instrument has an acceleration voltage range of 1kV-30kV and scan speeds up to 50ns per pixel. The SmartSEM software is capable of 4-D imaging, elemental mapping, remote viewing, and is user friendly, offering a number of customizable preferences unique to each user. Atlas Imaging software is also included, and enables automatic site to site scanning for mosaic compositions. The room has been outfitted for magnetic interference cancellation, electrical stability, and vibration reduction.

7C. Confocal and Live Cell Microscopy: The Core includes a Confocal Facility, which is equipped with a Zeiss LSM 700 including two spectral channels and a live cell imaging workstation . The confocal microscope is based on an Axio Observer Z1 motorized inverted microscope with four laser excitation lines from four solid-state diode lasers: 405nm, 488nm, 555nm, and 635nm. The instrument is equipped with a motorized scanning stage with controller. It also has the Zeiss Definite Focus controller for extremely precise focus control during long-term conditions where focus drift is a problem. The Live Cell Imaging microscope is based on a Zeiss Axio Observer D1 inverted microscope and is equipped with an XL-3 Incubator heated stage fitted with a CO_2-supplied cover plate. This incubation system enables precise temperature control and CO_2 supply for the specimen enabling extended imaging experiments.
The instrument uses the Zeiss ZEN Windows-based software, which is user-friendly and logical. The IM Research CORE facilities are available for use by the RUMC community and outside users under the directorship of Steve Mangos, Ph.D. Access to the facilities is restricted by swipe card access, which is only granted to approved, trained users and staff. A 1 hour training and certification program is required for all users and is available through the IM Research CORE Facilities Director.

8. The Biological Safety Level 3 (BSL3) Laboratory

The BSL3 facility (JS 1183) is a negative pressure biohazard containment facility that consists of an anteroom (90 ft^2) and laboratory (430 ft^2). The facility was totally renovated in 2011 to conform to current Biosafety in Microbiological and Biomedical Laboratories (CDC-NIH, BMBL, 2007) standards for handling RG3 agents, large volume isolation of RG2 agents, as well as new and uncharacterized pathogens when found or genetically modified human pathogens as described in the current NIH OBA current guidelines covering "Recombinant or Synthetic Nucleic Acid Molecules." The facility would be invaluable as a support laboratory during a bioterrorism

event and RUMC's response. The facility would also be useful for BSL2+ risk level experiments such at the propagation of drug resistant *Mycobacterium tuberculosis.* The facility is recertified annually to meet current CDC/NIH requirements. The facility is connected to RUMC emergency power and is designed to maintain containment and security during emergency conditions. All exhaust from the BSL3 is HEPA filtered before it is vented to the outside. A Steris pass-through steam sterilizer between the vestibule and main laboratory is equipped with appropriate biosafety collar, one-way pass through control, and backup steam generator. The main laboratory consists of two work areas. On area has two biological safety cabinets (BSC), one 4 foot and one 6 foot, the other area has a single 6 foot BSC. The BSCs are certified annually by an outside contractor. Each area has a dual chambered 37°C CO_2 incubator. Additional shared equipment includes a 4°C refrigerator (24 ft^3), a -30°C freezer (24 ft^3), a -80°C freezer (20.4 ft^3), three high capacity table top centrifuges (two refrigerated), three micro-centrifuges (two refrigerated), two microscopes, and a Coulter AcT10 cell counter. The refrigerator, the two freezers, the incubators, and the room are equipped with micro-sensors that continuously monitor temperature and wirelessly transmit their data to a centralized computer as part of a Siemens Checkpoint System, which automatically alerts specified people to any problems. The BSL-3 Laboratory is available for use by the RUMC community under the directorship of James W. Bremer, Ph.D. Access to the BSL-3 facility is restricted by swipe card access which is only granted to approved, trained staff. A 4-hour training and certification program is available and required of all users.

9. College of Health Sciences Shared Laboratory

Health science treatments and technology have exploded in the last 30 years, and there is a continuing and growing demand for health sciences faculty to perform research in the treatments of diseases and in the assessment of treatment efficacy. Keeping with the commitment of Rush University to research and education, our College of Health Sciences Shared Laboratory provides opportunities for faculty and students to perform research in a common space and thereby share skills, ideas, and research expertise. This fully equipped 500-square-foot laboratory is amenable to both human subjects research and basic biological research. Human subjects research is facilitated by a private office space designed for interviewing subjects, making measurements, and collecting specimens. Biological research is possible with an adjoining wet lab space, equipped with a biological safety cabinet, CO_2 cell culture incubator, centrifuge, -80ºC freezer, 96-well microplate visible light absorbance reader, high pressure liquid chromatography apparatus, microscopes and other necessary equipment. For further questions, please contact **Douglas Kuperman,PhD**, laboratory manager at **douglas_kuperman@rush.edu**.

10. Bioinformatics/Biostatistics Core

The Rush Bioinformatics and Biostatistics Core provides advanced biostatistics and bioinformatics resources to a wide range of clinical and population health researchers within the institution to enhance the capabilities of research community at Rush. The Core was established by Rush's Chief Analytics Officer, Bala Hota, MD, MPH. It provides support in several areas of health research – formulation of scientific hypothesis, selection of sampling design, designing of clinical studies and randomized trials, protocol development, evaluation of data resources, including data extracts from electronic medical records, development of data collection instruments through web-based and standalone modules, and development of clinical databases, and design and analysis of gene-based association studies. The Rush Core maintains 8 FTEs, including 1 PhD level statistician, 3 statisticians, and 4 senior level data analysts and developers. Core staff can provide statistical analysis on a wide array of studies – data extracted from medical records, and cross-sectional and prospective study of population and clinical studies of

health outcomes, and assist with interpreting statistical findings. Staff also perform power analysis and sample size calculations, prepare the data analysis sections for grant applications, create randomization schemes for the study, assist in planning the data collection procedure, write and review statistical sections of manuscripts prior to publication, and provide statistical education and mentorship for study design concepts and interpretation of study findings. The Core also provides access to data for researchers from the electronic record and external data sets for linkage and/or analysis.

Infrastructure. Rush has been a national leader in the implementation and integration of systems across the enterprise. The implementation of EPIC, deployed at Rush and Rush Oak Park and across hospital, emergency departments, and outpatient practices, has enabled Rush to achieve the Stage 6 HIMSS designation (achieved by only 5% of health systems) and gives a holistic, integrated view of patient care in one electronic system. The Core is well integrated within both Hospital Information Systems and Clinical Research, and overseen by the Chief Research Information Officer.

The core has built a state-of-the-art computing system, called the research private cloud, in consultation with Rush IS/IT that can support research activities and large databases that can extract electronic medical records of patient data, electronic case report forms from RedCAP data collection system; and biospecimen data. Survey instruments are available on demand to investigators through an on Site implementation of RedCAP.

The research private cloud is composed of an Application Layer (virtualizable; with 72 Cores, 3 TB memory, and 288 threads allocable for use) and a Database layer (Windows 2012 server, SQL Server 2014 enterprise, and 16 TB solid state drive space housing clinical data warehouses). The Cloud hosts an MS SQL database storing research related data and is planned to support virtual environments for researchers, and Hadoop related tools for Big Data analyses. The core also has a dedicated computing cluster for genetic, RNA-seq, and next generation sequencing studies.

Data sources. RUSH maintains an Enterprise Data Warehouse comprised of clinical and administrative data derived from our EPIC Electronic Medical Record and associated clinical IT systems. This single source EDW supports all clinical, research, and operational needs and contains administrative data for greater than 10 years and clinical data back to 2007. RUMC currently uses Epic for nearly all clinical and revenue cycle applications across the enterprise, including inpatient, ambulatory, ED, operating room, oncology, pharmacy, registration/scheduling, professional billing, facility billing and patient portal activities. RUMC has extensively customized Epic to support quality measurement, decision support, and interactions with our patients through the patient portal implementation. A patient portal application is available to serve as a means of communication with, assessing the health outcomes of, and recruiting patients for participation in studies.

Extracts from the electronic record are curated and housed in the RUSH DISCOVER Repository Data Mart. Derived from the global knowledge management infrastructure of Rush (called Maestro), DISCOVER houses data sets and hosts views from data domains within the Rush enterprise, and protects data through governance processes and the function of an honest broker. Investigators are offered the ability to have a hosted environment for their data, with access to their data through self-service tools (see below). Data are de-identified through the use of an honest broker. Data sources within the RUSH DISCOVER Repository are linked to EPIC data found within the EPIC data warehouse (Clarity); linked datasets include subsets of Clarity with

pre and post-processing, as well as relevant Cogito data; Pathology reports with National Language Processing derived interpretations; Radiology Reports with NLP derived interpretations; Microbiology and Laboratory Results; Operative Data; Rush Research Portal data; electronic Case Report Forms obtained from the RedCAP data collection system; and biospecimen data generated from instruments. Data standards in use at RUMC include use of ICD-9/10; CPT coding; SNOMEDCT for clinical concepts; RxNorm for medications; and LOINC coding for clinical laboratory tests. Survey instruments are available on demand to investigators through an on Site implementation of RedCAP, which is maintained by corporate IT. The data model for the research data has been standardized and is a superset of the national Patient-Centered Outcomes Research Network (PCORnet) data model, of which Rush is a participant. Rush has also successfully mapped research data to the Observational Medical Outcomes Partnership Common Data Model (CDM), allowing for participation in national research endeavors. Users access data from the RUSH DISCOVER Repository via several options of user interfaces: a self-service portal which can be used to generate count data and demographic information for cohorts; third party software which can identify cohorts on demand through custom tools; and a SQL user interface which can access the research data set through ad hoc queries, views, and stored procedures.

11. Rush Bio Specimen Freezer Facility

Rush has a centrally-located, 2500-square foot freezer facility. The facility includes a mixture of cryogenic storage units, -80°C mechanical freezers (many with liquid nitrogen backup cooling), -20°C freezers, and refrigeration units for large tissue samples. Storage units are digitally monitored to give automatic notification of temperature excursions or mechanical failure to both maintenance personnel and to the response tree established by the investigator. Access to the facility is electronically controlled and monitored. This facility provides improved security for specimen collections including an Alzheimer's brain tissue library, and preserves space in the investigators' laboratories. The administrative director of this facility is Thomas J. Champagne, Jr.

12. Neighboring University Core Research Facilities

In addition to the in-house Cores described above, Rush researchers have access to Core facilities at both the University of Chicago and the University of Illinois at Chicago. External Core Director contact information and laboratory locations are available on the respective web sites. The UIC labs are all within walking distance of the Rush campus.

13A. **University of Chicago (Office of Shared Research Facilities)**

- Animal Resource Center
- Biomolecular NMR Facility
- Biophysics Core Facility
- Biostatistics Core Facility
- Cellular and Tissue Based Processing cGMP Facility
- DNA Sequencing and Genotyping
- Electron Microscopy
- Electron Microscopy: Cryopreservation and Tomography
- Fitch Monoclonal Antibody Facility
- Flow Cytometry Facility
- Functional Genomics Facility

- Human Immunological Monitoring Facility
- Human Tissue Research Center
- IBD NanoBiology Facility
- Immunohistochemistry Facility
- Integrated Light Microscopy Core
- Mechanical/Technical Core
- MR Imaging Research Facility
- Pharmacology Core
- Proteomics Core Laboratory
- Scientific Visualization and Image Analysis
- Small Animal Imaging Facilities
- Transgenic Mouse/Embryonic Stem Cell Facility

13B. **University of Illinois at Chicago (Research Resources Center)**

- Imaging Center
- Electron Microscopy Service
- MRI for Animal Imaging
- Flow Cytometry Service
- DNA Services (sequencing)
- Core Genomics Facility (gene expression array and mass spectrometry)
- Center for Research Informatics
- Biospecimen Repository
- Pathology/RRC Research Histology and Tissue Imaging Core
- Center for Structural Biology
- Mass Spectrometry, Metabolomics & Proteomics Facility
- NMR and microMRI Lab
- High Throughput Screening Facility (cellular response to large chemical libraries)
- Protein Research Laboratory
- Transgenic Production Service
- Physiology Core, Center for Cardiovascular Research
- Scientific Instrument Shop (both fabrication and repair)
- RRC Scientific Supply Center (discounted supplies and reagents are stocked for immediate pickup)

The Rush Research Mentoring Program

The Research Mentoring Program was established July 26, 2006 in order to provide advanced mentoring by funded NIH investigators to an ever-growing population of young faculty. The goal of the program is to prepare junior faculty members at Rush and Stroger Hospital of Cook County to lead funded programs of translational research.

To help junior faculty members become independent researchers, the program relies on two primary mechanisms: good mentoring and resource infrastructure. Mentees are paired with at least one externally funded, experienced, and committed lead mentor who works very closely with the mentee on her/his research project; many mentees also have interdisciplinary mentoring teams. The program's resources include: statistical analysis, data management, professional grant writing and manuscript editing, graphics consultation, communication skills workshops, monthly "in-house study section" meetings, weekly mentee writing groups, monthly workshops and

seminars on a variety of research-related and grant-writing topics, a lending library, and an annual symposium.

Mentees are nominated to the program by their section heads/chiefs with the commitment of least 20% protected research time. In addition, mentees are expected to dedicate an additional 20% of their personal time for research. The program has two translational research tracks – clinical and laboratory-based. Each track meets monthly where mentees discuss their research in progress.

The program has enjoyed university-wide popularity and success. In the past ten years combined, mentees (either as principal investigators or as co-investigators/collaborators) have secured or were instrumental in securing close to $78 million in awards, 40% of which are from the NIH. Also, over 2000 manuscripts have been published by mentees to date, since their joining the program. The program has more than 80 active mentors. The program director is Giselle Sandi, Ph.D.

For a full description of the program, visit the website at www.rushu.rush.edu/mentoringprogram

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