National Cancer Institute

17th Annual Innovative Molecular Analysis Technologies (IMAT) Principal Investigators' (PI) Meeting

December 1-2, 2016

John E. Porter Neuroscience
Research Center, Building 35
Bethesda, Maryland

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
National Institutes of Health

Welcome

Welcome to the 17th Annual Principal Investigators' (PI) Meeting for the NCI Innovative Molecular Analysis Technologies (IMAT) program. As many of you already know, this annual meeting is organized to address two important aims of the IMAT program: (1) to provide NCI a chance to interact directly with PIs and receive an update on progress to date with supported research and (2) to provide an opportunity for interactions and exchange of ideas among meeting participants. The latter aim serves as a critical opportunity to spark new project collaborations for either further improvement of supported technology platforms or to launch the development of entirely new technologies. The interactions are also an important opportunity for receiving critical feedback and guidance from a broad community, as well as for fostering dissemination of the exciting technologies emerging from IMAT-supported researchers. Researchers from NCI's intramural laboratories of the Center for Cancer Research have again been invited to attend this meeting and encouraged to engage IMAT PIs.

This year, the IMAT program team is working to advance three new elements in the program. The first is an interest in more directly incorporating the perspective of our ultimate stakeholders, which are the cancer patients that might ultimately benefit from advances supported by the program. The second is a collaboration launched through the Vice President's Cancer Moonshot Initiative between the NCI and the Global Center for Medical Innovation (GCMI). GCMI puts emerging technologies through a development "proving grounds" pipeline to best position them for follow-on investment, enable commercialization and thereby make them more readily available for patients. The third is to establish more collaborative ties between investigators supported by the IMAT program and those in the NCI's Informatics Technologies for Cancer Research (ITCR) program. All three initiatives will be discussed during the meeting and you should reach out to NCI program staff for additional details.

As is always the case (but even more so this year than in the past) there are many more exciting active research projects in the IMAT portfolio than we could allow sufficient speaking time for, so we will continue our practice of having short "Poster Highlight" presentations for those investigators presenting particularly interesting progress. As these are short presentations, you are encouraged to seek details from their posters during the poster sessions. Please note that different posters will be presented at the two poster sessions because of the large number of currently active projects. In addition to the agenda and presentation abstracts provided, a list of resources and funding opportunities we thought might be of interest to IMAT PIs are included toward the back of this program book.

On behalf of the NCI program staff and everyone involved in the planning for this meeting, I thank you for your participation, your interest, and the important work you all do to assist in our collective mission against cancer. I look forward to an exciting and productive meeting.

Sincerely,

Tony Dickherber, Ph.D.
IMAT Program Director, Center for Strategic Scientific Initiatives
Office of the Director, National Cancer Institute

Agenda

17th Annual Principle Investigators' Retreat

Day 1 – Thursday, Dec 1, 2016

Time	Description
8:30 – 8:45 AM	**Welcome and State of the Program** Tony Dickherber NCI Center for Strategic Scientific Initiatives
8:45 – 10:45 AM	**Tools for Discovery Science**
8:45 AM	**Validation and Advanced Development of Duplex Sequencing** Lawrence Loeb University of Washington
9:00 AM	**High Precision Single Cell Whole Genome Application for Cancer Diagnosis** Sunney Xie Harvard University
9:15 AM	**A Novel Single-Molecule Telomere Characterization Technology for Analyzing Cancer** Harold Riethman Old Dominion University
9:30 AM	**Sensor-Seq: A Genome-Wide Biological Measure of miRNA Activity** Brian Brown Icahn School 0f Medicine at Mount Sinai
9:45 AM	**High Density Peptide Arrays for Cancer-Related Post-Translational Modifications** Mary Ozers Proteovista, LLC
10:00 AM	**Shedding Light on the Roles of Glycosylation in Cancer Development** Joseph Zaia Boston University Medical Campus

Time	Description
10:15 AM	**Improving Aptamer Development** Matthew Levy Albert Einstein College of Medicine
10:30 AM	**New Reagents for Tracking Protein Oxidation in Cells by MS and Imaging Methods** Cristina Furdui Wake Forest University Health Sciences
10:45 – 11:05 PM	**Coffee Break**
11:05 – 12:20 PM	**Panel Discussion: Frontiers of Cancer Epigenetics** Panel Moderator: Sean Hanlon, NCI\CSSI **Panelists:** • Xiaowei Chen (Fox Chase Cancer Center) o **A Novel Allele-Specific RNA-ISH for Differential Allele-Specific Expression** • Adam Hall (Wake Forest School of Medicine) o **Molecular Detection of DNA Hydroxymethylation for Cancer Screening** • Stephanie Byrum (University of Arkansas for Medical Sciences) o **Quantitative Mass Spectrometric Analysis of Histone Lysine Methylation from FFPE Tissues** • Olivier Harismendy (University of California San Diego) o **Genome-Wide Location Analysis of DNA Adduct in Whole Cells** • Pavel Petukhov (University of Illinois at Chicago) o **Photoreactive Histone Deacetylase Probes for Chromatin Immunoprecipitation in Cancer** • Robert Turesky (University of Minnesota School of Medicine) o **Carcinogen DNA Adduct Biomarkers in Formalin Fixed Tissues** • Ryan C. Bailey (University of Michigan) & Tamas Ordog (Mayo Clinic) o **Droplet Microfluidics for Low Input Epigenetics**

Time	Description
12:20 – 1:20 PM	**Lunch (on your own)**
1:20 – 1:50 PM	**Invited Presentation(s) – Seeking the Patients' Perspectives** Amy Williams, NCI Office of Advocacy Relations AnneMarie Ciccarella, Patient Research Advocate **Q&A Panel** • Amy Williams, Laurie Cynkin (NCI\OAR), AnneMarie Ciccarella and Melissa Thompson (Patient Advocate)
1:50 – 3:45 PM	**Advancing Clinical Capabilities**
1:50 PM	**Resources and Priorities from the NCI Division of Cancer Treatment and Diagnosis** Rodrigo Chuaqui & Lokesh Agrawal NCI\DCTD
2:10 PM	**High-Throughput, Multiplexed Detection of miRNA Biomarkers in Single Cancer Cells** Rong Fan & Patrick Doyle Yale University
2:25 PM	**Development of a Millifluidic Device and the 3D Imaging Infrastructure Towards Preservation and Processing of Tissue Biopsies for Pathology** Eric Seibel University of Washington
2:40 PM	**Highly Multiplexed Ion-Beam Tissue Molecular Imaging with Sub-Micron Resolution** Garry Nolan Stanford University
2:55 PM	**Adapting Single-Cell Mass Cytometry for Analysis of Solid Tumors** William Weiss University of California, San Francisco
3:10 PM	**Implantable Device for High-Throughput Drug Sensitivity Testing** Michael Cima Massachusetts Institute of Technology

Time	Description
3:25 PM	***In Vivo* Metal-Free Cycloaddition Chemistry Driven Pretargeted Cancer Radiotherapy** Thomas Quinn University of Missouri-Columbia
3:40 PM	**Wrap up** Rodrigo Chuaqui
3:45 – 4:00 PM	**Coffee Break**
4:00 – 4:30 PM	**IMAT-ITCR Collaborations**
4:00 PM	**Overview of ITCR and IMAT-ITCR Collaborations** Juli Klemm NCI Center for Bioinformatics and Information Technology
4:10 PM	**Tools to Analyze Morphology and Spatially Mapped Molecular Data** Joel Saltz Stony Brook University
4:30 – 5:20 PM	**Poster Session I Highlights**
	Evaluation of Protein Stability in Dried Plasma Spots Using Targeted and Untargeted Mass Spectrometry Techniques Konstantinos Petritis Phoenix Children's Hospital
	Direct Tumor Glycan Profiling on Tissue Microarrays Richard Drake Medical University of South Carolina
	Non-Invasive Sampling of Skin Biomarkers for Cancer Risk Assessment Samir Mitragotri University of California Santa Barbara
	Precise and Ultrasensitive Quantitation of Low Prevalence Somatic Mutations Using Single Molecule Molecular Inversion Probes (smMIPs) Stephen Salipante University of Washington

Time	Description
	Scalable Cancer Genomics via Nanocoding and Sequencing David Schwartz University of Wisconsin-Madison
	Digital One-Disc-One-Compound Array for High-Throughput Discovery of Cancer-Targeting Agents Tingrui Pan University of California At Davis
	Advanced Proteomic Methods for Tumor ECM Characterization Kirk Hansen University of Colorado Denver
	TempO-Seq Gene Expression Profiling from FFPE Bruce Seligman Biospyder Technologies, Inc.
	Kinase Profiling with Quantititative Chemoproteomics Dustin Maly University of Washington
	Digital Detection of Tumor-Derived Circulating Methylated DNA Jeff Wang Johns Hopkins University
5:20 – 7:00 PM	**Poster Session I**
7:00 PM	**Adjourn Day 1**

Day 2 – Friday, Dec 2, 2016

Time	Description
8:30 – 8:45 AM	**Day 2 Welcome and New Opportunities**
8:30 AM	**Introducing the Global Center for Medical Innovation & T3 Labs** Tiffany Wilson GCMI & T3 Labs
8:45 – 9:30 AM	**Novel Biosensors**
8:45 AM	**Photonic Crystal Enhanced Fluorescence: Development of Sensors Structures and Detection Instrumentation for Early Cancer Biomarker Detection** Brian Cunningham University of Illinois at Urbana-Champaign
9:00 AM	**Single Molecule Microarrays for the Detection of Mutant DNA in Body Fluids** Alfredo Celedon Scanogen, Inc.
9:15 AM	**Multiplexed phosphoprotein and miRNA profiling enabled by chip-integrated silicon photonic sensor arrays** Ryan Bailey & Mark Johnson University of Michigan & Brigham & Women's Hospital
9:30 – 10:30 AM	**Advancing Imaging**
9:30 AM	**Hyperspectral Stimulated Raman Spectroscopic Imaging Reveals a Novel Metabolic Signature in Cancer Stem Cells** Ji-Xin Cheng Purdue University
9:45 AM	**Ultrabright Probes for Highly Multiplexed Molecular and Cellular Analysis of Cancer** Daniel Chiu University of Washington

Time	Description
10:00 AM	**Kinase Binding Fluorescent Probes for Assaying Cellular Receptor Populations** James Wilson University of Miami Coral Gables
10:15 AM	**Non-Circulating Microparticles for Improved Localization and Resection Cancer** Sarah Blair University of California San Diego
10:30 – 10:45 AM	**Coffee Break**
10:45 – 11:45 AM	**Cancer Modeling**
10:45 AM	**Molecular Analysis of Physical Microenvironmental Control of Tumor Cell Invasion** Sanjay Kumar University of California Berkeley
11:00 AM	**Development of 3D Organ-Specific Models of Colorectal Cancer Metastasis** Andrew Wang University of North Carolina Chapel Hill
11:15 AM	**Microfluidic Approach for the Development of a Three-Dimensional Bone Marrow Microenvironment Model to Test Personalized Multiple Myeloma Treatments** Jenny Zilberberg & Woo Lee Hackensack University & Stevens Institute of Technology
11:30 AM	**Three Dimensional Culture of Primary Human Colonic Organoids: Optimization of Conditions, Characterization of Long-term Culture Effects, and Isolation of LGR5+ Stem Cells** Justin Colacino University of Michigan
11:45 – 12:30 PM	**Poster Session II Highlights**
	Validating Technology to Optimize Antibody Affinity for Targeting Therapeutics Mark Federspiel Mayo Clinic Rochester

Time	Description
	Large-Scale Characterization of Anti-Cancer Antibody Responses in Lung Adenocarcinoma William Robinson Stanford University
	Doxorubicine Stabilization and Monitoring in Saliva of Children with Cancer David Graham Johns Hopkins University
	High-Throughput *ex vivo* Microscopy of Cancer Biospecimens Using Structured Illumination Microscopy Quincy Brown Tulane University
	Fast Interference-Based Super-Resolution Microscope for Cancer Mechanobiology Warren Zipfel Cornell University
	Multiplexed Kinase Biosensor Technology to Detect Leukemia Signaling with Mass Spectrometry Laurie Parker University of Minnesota
	Isolating Circulating Tumor Cells Using a Centrifuge on a Chip Dino Di Carlo University of California Los Angeles
	High Quality CTC Isolation Using Microbubbles for Downstream Molecular Analysis Yu-Tsueng (YT) Liu University of California San Diego

Time	Description
	A Droplet-Based System for Capture, Manipulation, and Biochemical Profiling of Rare Cancer Cells Stefanie Jeffrey Stanford University
12:30 – 2:00 PM	**Lunch (On Your Own)** **and** **Poster Session II**
2:00 – 2:45 PM	**Liquid Biopsy Platforms**
2:00 PM	**New Tools for the Isolation and Molecular Profiling of Circulating Markers** Steven Soper University of Kansas
2:15 PM	**A Micro Hall Chip for Circulating Microvesicle-Based Cancer Monitoring** David Issadore University of Pennsylvania
2:30 PM	**Integrated Microfluidic Exosome Profiling for Early Detection of Cancer** Yong Zeng University of Kansas
2:45 – 3:30 PM	**Panel Discussion: Liquid Biopsies and Cancer Moonshots** **Moderator:** Lynn Sorbara NCI Division of Cancer Prevention **Panelists:** Steven Soper, David Issadore, Yong Zeng, Stefanie Jeffrey, Dino Di Carlo, YT Liu, Melanie Hayden
3:30 PM	**Adjourn Day 2**

Podium Presentation Abstracts

Day 1 Poster Presentations

Day 2 Poster Presentations

Resources and Funding Opportunities

Resources

- NCI's Proteomics Data Portal provides datasets of breast, ovarian, and tumor tissue that have been genomically characterized by TCGA datasets.
- The Antibody Characterization Laboratory provides access to a large number of reagents and accompanying characterization data. Antigens and antibodies are expressed, purified, and characterized using standard operating procedures, with all accompanying protocols and data.
- The Nanotechnology Characterization Laboratory (NCL) within Frederick National Laboratory for Cancer Research performs preclinical characterization of nanomaterials using a comprehensive battery of assays. The operation of NCL relies on collaboration with the Food and Drug Administration and the National Institute of Standards and Technology.
- The cancer Nanotechnology Laboratory (caNanoLab) data portal provides access to nanomaterial characterization data to expedite and validate the use of nanomaterials in biomedicine. Users can search and download cancer-relevant characterization data resulting from physico-chemical, *in vitro*, and *in vivo* assays, as well as associated protocols and publication information.
- The Nanomaterial Registry archives research data on nanomaterials and their biological and environmental implications from a broad collection of publically available nanomaterial resources. All data housed is curated using a set of minimal information about nanomaterials (MIAN) to create criteria for curation and enable nanomaterial comparisons.
- NCI's Physical Sciences-Oncology Network Data Coordinating Center provides datasets of genomic characterization and physical characterization of numerous non-malignant and malignant cell lines (https://nciphub.org/groups/nci_physci/psondcc).
- The NCI Physical Sciences-Oncology Network Bioresource Core Facility (PBCF) at ATCC is a central resource that provides common stocks of authenticated non-malignant and cancerous cell lines, their derivatives, cell culture reagents, and related standard operating protocols (SOPs). The bioresources are available for the cost of shipping and handling only, not only for members of the Physical Sciences-Oncology Network and Cancer Systems Biology Consortium, but also all investigators who are willing to share data sets that are generated using the bioresources provided by the PBCF. Visit the website to view the list of available cell lines and derivatives, the SOPs, order form, and transfer agreements: http://physics.cancer.gov/bioresources.
- The Early Detection Research Network (EDRN) – A consortium that promotes discovery, development, and clinical validation of biomarkers for early detection of cancer.

Investigators with promising biomarkers may request for core funds to validate their markers using reference sets and resources within the network.

- The NCI SBIR Development Center oversees all NCI Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) support programs, which includes all grant and contract funding opportunities, as well as a broad variety of additional resources aimed at supporting the innovations and commercial interests of small business entities against cancer.
- The Cancer Genomics Cloud Pilots are designed to explore innovative methods for accessing and computing on large genomic data. Three contracts were awarded to develop infrastructure and a set of tools to access, explore, and analyze molecular data, which are all being implemented through commercial cloud providers and adopting common standards. The three project teams have distinct system designs, data presentation, and analysis resources to serve the cancer research community, which will be made available to researchers in early 2016.
- The Cancer Genome Atlas (TCGA) Data Portal provides a platform for researchers to search, download, and analyze datasets generated by TCGA. It contains clinical information, genomic characterization data, and high-throughput sequencing analysis of the tumor genomes.
- The Alliance of Glycobiologists for Detection of Cancer – A consortium that investigates the molecular basis by which altered glycan expression leads to cancer progression and develop cancer biomarkers based on the aberrant expression of these glycans. Opportunities exist to collaborate in cancer relevant research with a number of experts in glycobiology.
- NCI Best Practices for Biospecimen Resources guiding principles that define state-of-the-science biospecimen resource practices, promote biospecimen and data quality, and support adherence to ethical and legal requirements. (https://biospecimens.cancer.gov)
- The Biospecimen Research Database (BRD) is a free and publicly accessible literature database that contains curated, peer-reviewed primary and review articles in the field of human biospecimen science. The database is searchable by various parameters including the biospecimen investigated (type and location, patient diagnosis), preservation method, analyte(s) of interest and technology platform(s) used for analysis. An original summary of relevant results is also provided for each article.
- The NCI offers the following two resources for research biospecimens:
    - Specimen Resource Locator (SRL) is a biospecimen resource database designed to help researchers locate resources that may have the samples needed for their investigational use. This publicly searchable database includes information about biospecimen banks and sample procurement services. The specimens and samples come from non-commercial, either NCI or non-NCI-funded resources. Investigators can search the database and gain access to thousands of

specimens of various tumor, organ, and preservation methods. https://specimens.cancer.gov

- The Cooperative Human Tissue Network (CHTN at https://chtn.org) is a resource developed and supported by the NCI that provides human tissues and fluids from routine procedures open to the scientific community to facilitate basic, early translation research, and assay/technology validation. Unlike tissue banks, the CHTN works prospectively with each investigator to tailor specimen acquisition and processing to meet their specific project requirements.

- The NCI Comprehensive Data Resource (CDR) is a distributed web-based system that manages and maintains multi-dimensional data models on biospecimens. CDR was developed and is currently utilized to collect biospecimen and clinical data on biospecimens collected from cancer patient donors and post-mortem donors, for the NCI's Biospecimen Pre-analytical Variables (BPV) and NIH Genotype-tissue Expression (GTEx) programs.
- NCI has developed the Biobank Economic Modeling Tool (BEMT), a publically available web-based financial planning tool for biobanks. BEMT is designed to enhance the understanding of the economic considerations involved in initiating, operating and maintaining a biobank to assist with long term financial planning and cost recovery.
- The NIH Library of Integrated Network-based Cellular Signatures (LINCS) Program aims to create a network-based understanding of biology using computational tools into a comprehensive view of normal and disease states that can be applied for the development of new biomarkers and therapeutics. By generating and making public data that indicates how cells respond to various genetic and environmental stressors, the LINCS project will help us gain a more detailed understanding of cell pathways and aid efforts to develop therapies that might restore perturbed pathways and networks to their normal states.

Active Research Funding Opportunities[1]

Innovative Molecular Analysis Technology (IMAT) Program

- RFA-CA-17-010: Innovative Molecular and Cellular Analysis Technologies for Basic and Clinical Cancer Research (R21)
- RFA-CA-17-011: Advanced Development and Validation of Emerging Molecular and Cellular Analysis Technologies for Basic and Clinical Cancer Research (R33)
- RFA-CA-17-012: Innovative Technologies for Cancer-Relevant Biospecimen Science (R21)
- RFA-CA-17-013: Advanced Development and Validation of Emerging Biospecimen Science Technologies for Basic and Clinical Cancer Research (R33)
- Applications due Feb 28, May 26 and Sept 26, 2017.
- NCI is currently considering reissuance of the SBIR-IMAT program announcement. Updates for this FOA will be posted at both the IMAT and NCI SBIR Development Center websites.

Alliance for Nanotechnology in Cancer

- PAR-14-285: (U01) Innovative Research in Cancer Nanotechnology (IRCN). Expires April 15, 2017.

NCI Physical Sciences in Oncology Network (PSON)

- PAR-15-021: (U01) Physical Sciences-Oncology Projects (PS-OP). Applications due May 26, 2017; and September 21, 2017.

Assay Validation for High Quality Markers for NCI-Supported Clinical Trials

- PAR-15-095 (UH2/UH3)
- PAR-15-096 (UH3)
- Applications due: February 9, 2017; July 7, 2017; and October 6, 2017.

Academic-Industrial Partnerships

- PAR-15-075: (R01) Translation of Technologies for Cancer Diagnosis and Treatment. Expires Jan. 8, 2018.

Global Health Technologies for Cancer

- PAR-15-276: (R01) Turkey-US Collaborative Program for Affordable Medical Technologies. Expires Jan. 8, 2017.

[1] Standard receipt dates apply, unless specific receipt dates listed.

Informatics Technologies for Cancer Research (ITCR) Program

- PAR-15-334: (R21) Development of Innovative Informatics Methods and Algorithms for Cancer Research and Management
- PAR-15-332: (U01) Early-Stage Development of Informatics Technologies for Cancer Research and Management
- PAR-15-331: (U24) Advanced Development of Informatics Technologies for Cancer Research and Management
- PAR-15-333: (U24) Sustained Support for Informatics Resources for Cancer Research and Management
- Applications due: June 14, 2017; November 20, 2017; and June 14, 2018.

Cancer Systems Biology Consortium (CSBC)

- RFA-CA-15-014: (U54) Research Centers for Cancer Systems Biology Consortium; Applications due Apr 20, 2017.
- PAR-16-131 (U01) Emerging Questions in Cancer Systems Biology; Expires Nov 25, 2017

Global Health Technologies for Cancer

- PAR-15-276: (R01) Turkey-US Collaborative Program for Affordable Medical Technologies. Expires Jan. 8, 2017.

Oncology Models

- PAR-14-240: (Collaborative R01) Collaborative Research Projects to Enhance Applicability of Mouse Models for Translational Research. Expires May 8, 2017.
- PAR-14-241: (R01) Research Projects to Enhance Applicability of Mouse Models for Translational Research. Expires May 8, 2017.
- PAR-15-266: (U24) Oncology Co-Clinical Imaging Research Resources to Encourage Consensus on Quantitative Imaging Methods and Precision Medicine. Applications due: June 14, 2017; November 17, 2017; and June 14, 2018.
- PAR-16-105: (U01) Cancer Tissue Engineering Collaborative: Enabling Biomimetic Tissue-Engineered Technologies for Cancer Research. Applications due May 30, 2017; November 30, 2017; May 30, 2018; and November 30, 2018.

Adducts in Cancer Risk Identification and Prevention

- PAR-15-307: (U01) Translational Research on Adducts in Cancer Risk Identification and Prevention
- PAR-15-308: (R01) Innovative Basic Research on Adducts in Cancer Risk Identification and Prevention
- PAR-15-309: (R21) Innovative Basic Research on Adducts in Cancer Risk Identification and Prevention
- Applications due July 11, 2017, November 21, 2017; and July 11, 2018.

Other NCI opportunities

- PAR-14-116: (U01) Quantitative Imaging for Evaluation of Response to Cancer Therapies. Expires May 8, 2017.
- PAR-15-104: (U01) Core Infrastructure and Methodological Research for Cancer Epidemiology Cohorts. Applications due March 10, 2017.
- PAR-15-266: (U24) Oncology Co-Clinical Imaging Research Resources to Encourage Consensus on Quantitative Imaging Methods and Precision Medicine. Applications due Jun 14, 2017, Nov 17, 2017, and Jun 14, 2018.
- PAR-15-287: (U01) Opportunities for Collaborative Research at the NIH Clinical Center. Applications due April 11, 2017, April 11, 2018.
- PAR-15-289: (U01) The Pancreatic Cancer Detection Consortium. Applications due May 26, 2017; September 21, 2017, April 6, 2018.
- PAR-16-044**:** (R01) Image-Guided Drug Delivery. Applications due June 21, 2017; November 22, 2017; June 21, 2018; November 22, 2018**.**
- PAR-16-089: (U01) Imaging and Biomarkers for Early Cancer Detection of Aggressive Cancers**.** Applications due December 14, 2016; July 10, 2017; December 11, 2017; July 10, 2018; and December 11, 2018**.**
- PAR-16-166**:** (U01) Integrating Biospecimen Science Approaches into Clinical Assay Development. Applications due February 13, 2017; October 11, 2017; and June 22, 2018**.**
- PAR-16-176**:** (R21) NCI Clinical and Translational Exploratory/Developmental Studies. Applications due February 21, 2017; June 19, 2017; October 17, 2017; February 20, 2018; June 19, 2018; October 17, 2018; and February 20, 2019.
- PAR-16-217 (R21) & PAR-16-218 (R01) Research Answers to NCI's Pediatric Provocative Questions; Expires Nov 25, 2017
- PAR-16-276: (R01) Program to Assess the Rigor and Reproducibility of Exosome-Derived Analytes for Cancer Detection. Applications due June 13, 2017; October 13, 2017; June 13, 2018; October 15, 2018; and June 13, 2019.
- PAR-16-277: (R21) Program to Assess the Rigor and Reproducibility of Exosome-Derived Analytes for Cancer Detection. Applications due June 13, 2017; October 13, 2017; June 13, 2018; October 15, 2018; and June 13, 2019**.**

Novel Nucleic Acid Sequencing Technology Development

- RFA-HG-15-031 (R21)
- RFA-HG-15-032 (R01)
- RFA-HG-15-033 (R43/R44)
- RFA-HG-15-039 (R44)
- Applications due October 27, 2015; July 14, 2016; June 15, 2017

General NIH Bioengineering Research Opportunities

- PAR-17-046: (R21) Exploratory Research for Technology Development from the National Institute for General Medical Sciences, Expires May 8, 2019
- PAR-17-045: (R01) Focused Technology Research and Development from the National Institute for General Medical Sciences, Expires May 8, 2019
- PA-16-040: (R21) Exploratory/Developmental Bioengineering Research Grant (EBRG), Expires Jan 8, 2019
- PAR-16-242: (R01) Bioengineering Research Grants (BRG). Expires May 8, 2019.
- PAR-16-116: (U01) Bioengineering Research Partnerships (BRP). Expires Jan 8, 2019.
- RFA-EB-09-003: (U01) NIBIB Quantum Program: Technological Innovation to Solve a Major Medical or Public Health Challenge. Applications due Jan 26, 2017.
- PAR-14-166: (R01) Early Phase Clinical Trials in Imaging and Image-Guided Interventions. Applications due Feb 9, 2017.
- PAR-15-085: (U01) Predictive Multiscale Modeling Program. Applications due: January 30, 2017; May 29, 2017; and September 29, 2017.

NIH Big Data to Knowledge (BD2K) Program

- PA-14-154: (R43/R44) Early Stage Development of Technologies in Biomedical Computing, Informatics, and Big Data Science
- PA-14-155: (R01) Early Stage Development of Technologies in Biomedical Computing, Informatics, and Big Data Science
- PA-14-156: (R01) Extended Development, Hardening and Dissemination of Technologies in Biomedical Computing, Informatics and Big Data Science
- PA-14-157: (R41/R42) Early Stage Development of Technologies in Biomedical Computing, Informatics, and Big Data Science
- Expires May 8, 2017

Early-life Factors and Cancer Development Later in Life

- PA-15-124 (R03)
- PA-15-125 (R21)
- PA-15-126 (R01)
- Expires Jan. 8, 2018.

Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative

- Various funding opportunities can be found at https://www.braininitiative.nih.gov

Diet and Physical Activity Assessment Methodology

- PAR-15-170 (R01)
- PAR-15-171 (R21)
- Multiple receipt dates, expiring September 8, 2018.

Technologies for Heart, Lung, and Blood Disorders

- RFA-HL-16-009: (R44) NHLBI SBIR Phase IIB Bridge Awards to Accelerate the Commercialization of Technologies for Heart, Lung, Blood, and Sleep Disorders and Diseases. Applications due June 19, 2017
- RFA-HL-15-030: (R44) Stem Cell-Derived Blood Products for Therapeutic Use: Technology Improvement. Applications due February 20, 2017.

Training and Other Support

Ruth L. Kirschstein National Research Service Award (NRSA)

- PA-14-015: (T32) Institutional Research Training Grant. Includes the Cancer Nanotechnology Research Training Program (please see NOT-CA-14-035).
- PA-14-147: (F31) Individual Predoctoral Fellowship
- PA-14-148: (F31) Predoctoral Fellowship to Promote Diversity in Health-Related Research
- PA-14-149: (F32) Individual Postdoctoral Fellowship (Parent F32)
- PA-14-150: (F30) Predoctoral MD/PhD or Other Dual-Doctoral Degree Fellowship
- PA-14-151: (F33) Individual Senior Fellowship. Expires January 8, 2017
- PA-14-048: (K25) Mentored Quantitative Research Development Award (Parent K25). Expires January 18, 2017.
- PAR-15-056: (K22) The NCI Transition Career Development Award. Expires November 17, 2017.
- RFA-HG-14-005: (T32) Revisions to Add Biomedical Big Data Training to Active Institutional Training Grants. Applications due July 28, 2016.

Genomic Resource Grants for Community Resource Projects (U41)

- PAR-14-191: Application Receipt Date(s): June 30, 2014; September 25, 2014; January 25, 2015; May 25, 2015; September 25, 2015; January 25, 2016; May 25, 2016; September 25, 2016; January 25, 2017

Early Stage Development of Technologies in Biomedical Computing, Informatics, and Big Data Science (R01)

- PA-14-155: Application Receipt/Submission Date(s): Standard dates apply. Expiration Date: May 8, 2017

Extended Development, Hardening and Dissemination of Technologies in Biomedical Computing, Informatics and Big Data Science (R01)

- PA-14-156: Application Receipt/Submission Date(s): Standard dates apply. Expiration Date: May 8, 2017

Discovery of *in vivo* Chemical Probes (R01)

- PAR-14-279: Application Receipt/Submission Date(s): Multiple dates, see announcement.