Biomedical Informatics Shared Resource

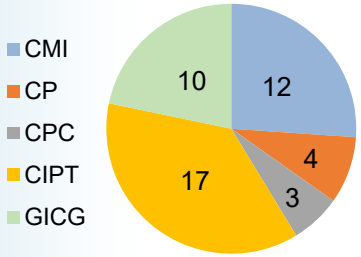
RUTGERS Cancer Institute of New Jersey
RUTGERS HEALTH

NCI Comprehensive Cancer Center
A Cancer Center Designated by the National Cancer Institute

Aims

- The BISR offers services that analyze multi-dimensional data sets, including genomic analyses and high-resolution imaging, through the development and implementation of machine-learning technologies in high-performance computing environments
- Through our extensive nationwide collaborations we are establishing CINJ as a leading resource in medical informatics by augmenting the Clinical and Research Data Warehouse (CRDW) capabilities to automate extraction, mapping, warehousing, and mining of data

Research Program Support (2018–2022)



47 Members
(1 not aligned)

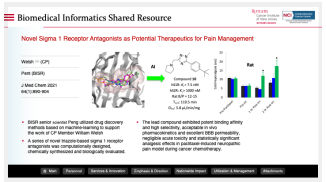
Publications

Total	145
Co-Authored	28
IF>10	17

Peer-Reviewed Grants

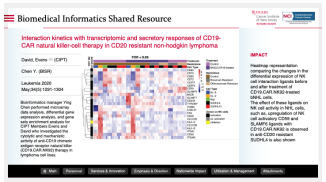
All	18 (2T)
NCI	14 (2T)

CP



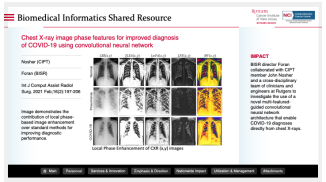
J Med Chem, 2021

CIPT



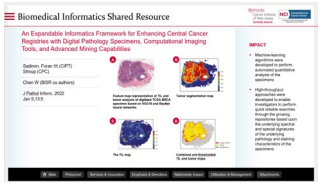
Leukemia, 2020

CIPT



Int J Comput Assist Radiol Surg, 2021

CIPT, CPC



J Pathol Inform, 2022

Leading Personnel & Roles

David Foran, PhD
Director

Wenjin Chen, PhD
Medical Imaging Manager

Ying Chen, PhD
Bioinformatics Manager

Youyi Peng, PhD
Senior Biomedical Informatics Specialist

Kevin Meehan
Associate Director, Information Technology (Clinical and Research Data Warehouse)

Services & Innovation

New

- Design, develop and optimize high-throughput processing and evaluation of digitized microscopy, radiologic imaging studies, genomics, and clinical correlates using cloud and supercomputing resources
- Automate extraction, mapping, warehousing, and mining of data originating from EMRs, clinical trials management systems, NGS studies, and pathology & radiology image archives
- Develop and optimize computational cutting-edge decision support algorithms, methods, and strategies to guide choices in treatment and therapy planning

Continuing

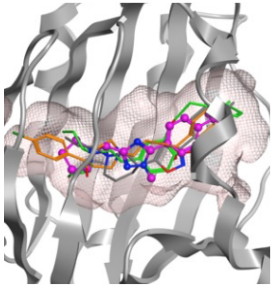
- Design and perform next-generation sequencing analysis to classify tumors and identify putative cancer driver genes, oncogenes, tumor suppressors, and genetic pathways
- Offer advanced multispectral imaging, color-decomposition and quantum dot conjugate technology to facilitate whole-slide, fluorescence, & advanced digital microscopy applications
- Provide advanced training, workshops, seminars, and educational programs for members, trainees, and more broadly the Rutgers community

Novel Sigma 1 Receptor Antagonists as Potential Therapeutics for Pain Management

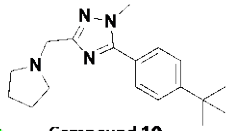
Welsh ✉ (CP)

Peng (BISR co-author)

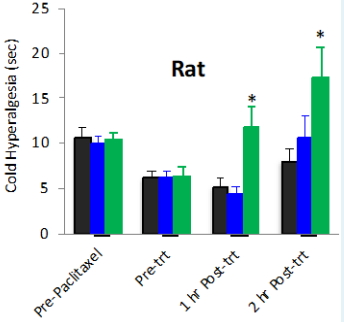
J Med Chem, 2021
64(1):890-904



AI



Compound **10**
hS1R: K_i = 7.5 nM
hS2R: K_i > 1000 nM
Rat B/P = 12-15
$T_{1/2}$: 119.5 min
Cl_{int}: 5.8 µL/min/mg



1) BISR senior scientist Peng utilized drug discovery methods based on machine-learning to support the work of CP Member William Welsh

2) A series of novel triazole-based sigma 1 receptor antagonists was computationally designed, chemically synthesized and biologically evaluated

3) The lead compound exhibited potent binding affinity and high selectivity, acceptable in vivo pharmacokinetics and excellent BBB permeability, negligible acute toxicity and statistically significant analgesic effects in paclitaxel-induced neuropathic pain model during cancer chemotherapy

IMPACT

- Pain modulation by S1R is primarily mediated through the central nervous system
- The development of S1R antagonists with improved oral bioavailability, metabolic stability, and efficacy would represent an invaluable step forward for the management of pain without addiction and other adverse effects associated with opioid drugs

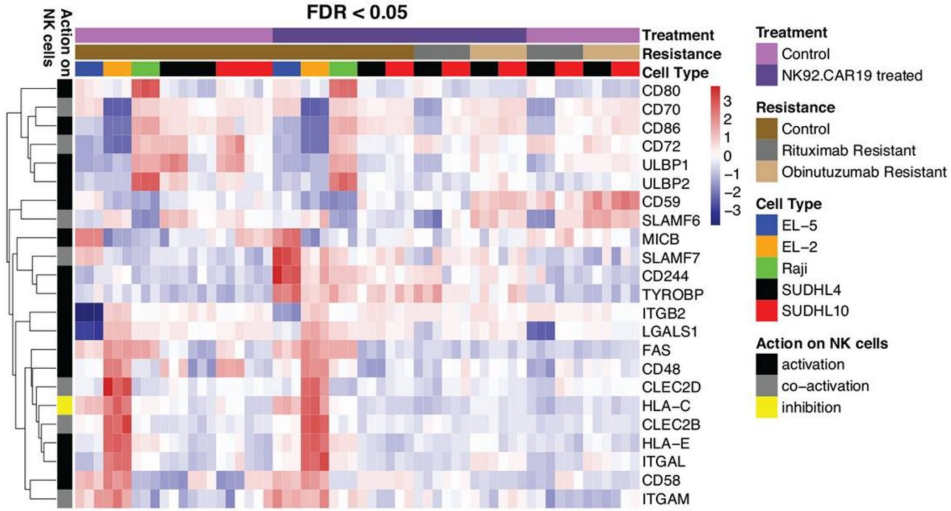
Interaction Kinetics with Transcriptomic and Secretory Responses of CD19-CAR Natural Killer-cell Therapy in CD20 Resistant Non-Hodgkin Lymphoma

David, Evens ✉ (CIPT)

Chen Y. (BISR co-author)

Leukemia, 2020
May;34(5):1291-1304

Bioinformatics manager Ying Chen performed microarray data analysis, differential gene expression analysis, and gene sets enrichment analysis for CIPT Members Evens and David who investigated the cytolytic and mechanistic activity of anti-CD19 chimeric antigen receptor natural killer (CD19.CAR.NK92) therapy in lymphoma cell lines



IMPACT

- CD19 is a cell surface protein ubiquitously expressed through all stages of B cell development and consistently present in all malignant B cells
- Anti-CD19 chimeric antigen receptor natural killer (CD19.CAR.NK92) therapy was associated with potent anti-lymphoma activity across a host of sensitive and resistant lymphoma cells that involved distinct immuno-biologic mechanisms

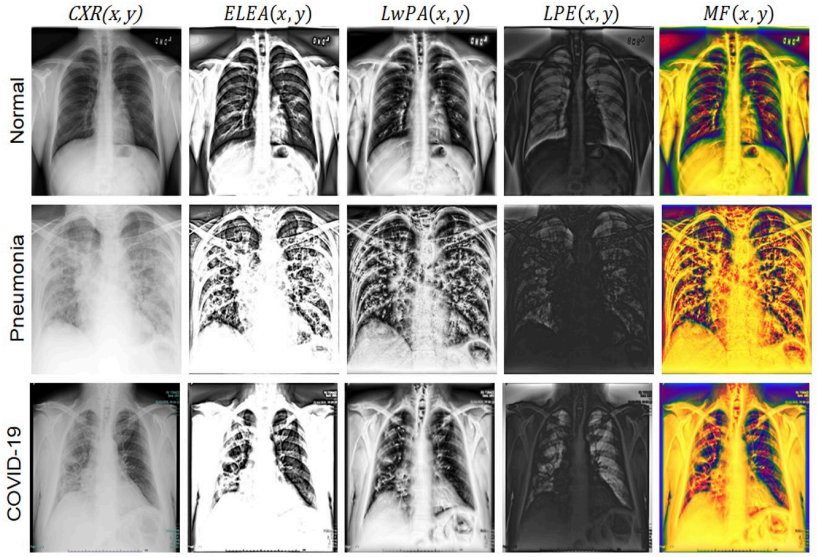
Chest X-ray Image Phase Features for Improved Diagnosis of COVID-19 using Convolutional Neural Network

Nosher (CIPT)

Foran (BISR co-author)

Int J Comput Assist Radiol Surg, 2021 Feb;16(2):197-206

Image demonstrates the contribution of local phase-based image enhancement over standard methods for improving diagnostic performance



Local Phase Enhancement of CXR (x,y) images

IMPACT

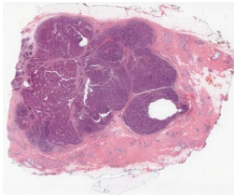
- BISR director Foran collaborated with CIPT member John Nosher and a cross-disciplinary team of clinicians and engineers at Rutgers to investigate the use of a novel multi-featured-guided convolutional neural network architecture that enable COVID-19 diagnoses directly from chest X-rays

An Expandable Informatics Framework for Enhancing Central Cancer Registries with Digital Pathology Specimens, Computational Imaging Tools, and Advanced Mining Capabilities

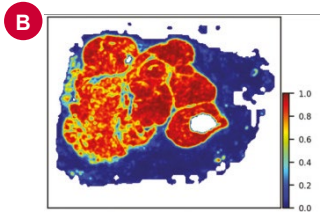
Sadimin, Foran ✉ (CIPT)
Stroup (CPC)

Chen W (BISR co-authors)

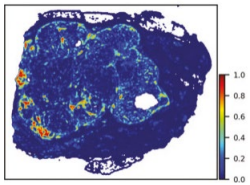
J Pathol Inform, 2022
Jan 5;13:5



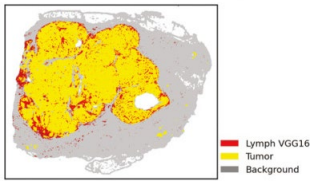
Feature map representation of TIL and tumor analysis of digitized TCGA BRCA specimen based on VGG16 and ResNet neural networks.



Tumor segmentation map



The TIL map



Combined and thresholded TIL and tumor maps.

IMPACT

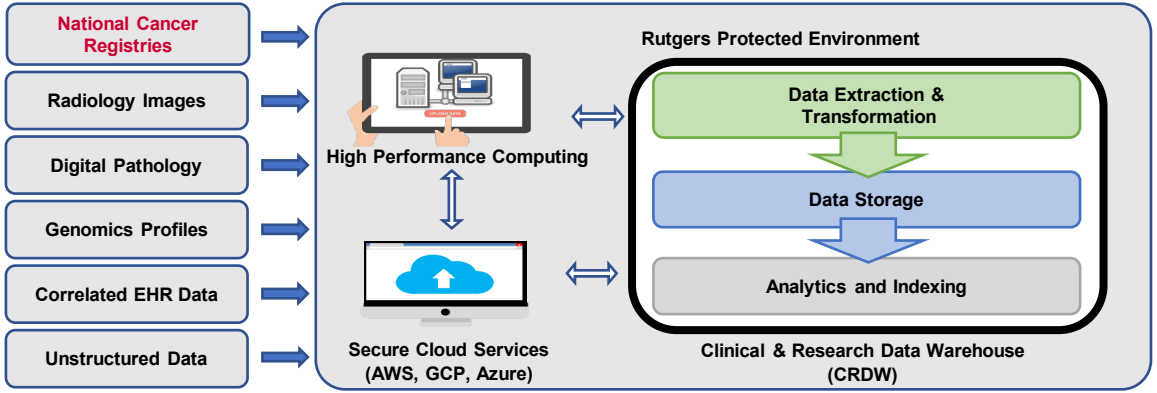
- Machine-learning algorithms were developed to perform automated quantitative analysis of the specimens
- High-throughput approaches were developed to enable investigators to perform quick reliable searches through the growing repositories based upon the underlying spectral and special signatures of the underlying pathology and staining characteristics of the specimens

Emphasis & Future Directions

Development of Multi-modal Clinical & Research Data Warehouse (CRDW)

IMPACT

BISR Director Foran led teams at Rutgers and RWJBH in the development and implementation of the CRDW that provides access to state-of-the-art AI & machine-learning pipelines and secure, high-performance computing resources



Environment provides 12 PB of high-performance data storage and 1.2 quadrillion mathematical operations per second, peak performance

Nationwide Impact

CINJ Clinical & Research Data Warehouse (CRDW)

NYU Langone Health

FOX CHASE CANCER CENTER

MD Anderson Cancer Network®
Certified Member

ETL and data model of CRDW was used to support two projects with the overarching objective to establish a COVID-19 data registry of patients with NYU, Buffalo, Einstein, Icahn, UPenn

CINJ CRDW and our imaging and genomic workflows serve as template for the development of “An Intelligent Retrieval and Interrogation System (IRIS) for Managing, Mining and Sharing Multi-modal Clinical Data for Investigative Research and Decision Support” with Boston VA

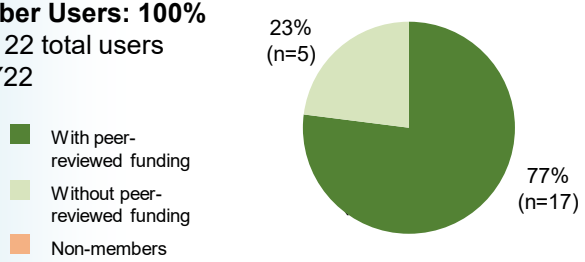
The CRDW is being optimized as part of the CTSA grant to gather and organize data across the NJ ACTS consortium. We are establishing Epic/RWJBH/NJ-ACTS Data Analytics workgroup focused on personalized medicine, clinical outcomes and population sciences

Our MPI submission with MD Anderson, Fox Chase, and NYU titled: “Quantitative liquid biopsy, radiomic, and pathomic biomarkers for localized pancreatic cancer” was selected for presentation to Foundation for the NIH in December 2022, and as a finalist for funding consideration

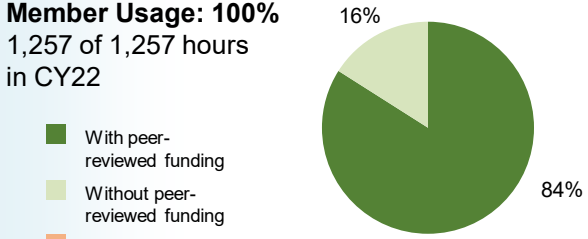
Biomedical Informatics Shared Resource

Utilization & Management

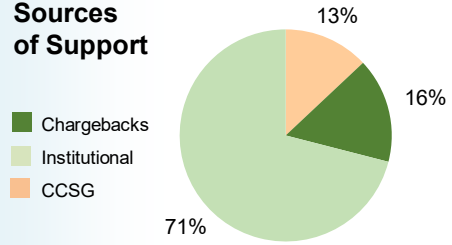
Member Users: 100%
22 of 22 total users in CY22



Member Usage: 100%
1,257 of 1,257 hours in CY22

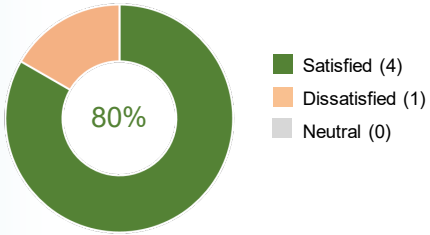


Sources of Support



FY24 Chargeback target: 20%

Satisfaction Survey for CY22 services



Participated: 5 of 22 members (23%)

Organization & Governance

BISR
8.0 FTE

SRACs
- Advisory Committee meets annually
- Discusses operational and scientific progress
- SRM supports organization

SRM
- SR Faculty Directors report to the ADSR
- SRM tracks and supports SRAC recommendations, productivity, service development, outreach

CINJ Director
- RLC
- Finance & Admin
- EAB

Supporting Information

Program Support

- Publications
- Grants
- 5-Year User List

Advisory Committee

- FY23 Presentation
- Action Items
- Notes

Quality Satisfaction

- Annual Survey Action Items

SR Usage

- CY22 Usage

Submitted Information

- Research Strategy
- Aims
- SRM Research Strategy