The NCI CIRP Program

Quantitative Imaging Research Resources At Preclinical and Clinical Setting

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CIRP Objectives

❑ **Establish co-clinical quantitative imaging protocols via revere-translation from clinical imaging setting to pre-clinical imaging setting, with emphasis on optimization of preclinical imaging,**

❑ **Use available, credential GEMMs or PDXs to re-capitulate disease biological features and to address important cancer issues for adult or pediatric diseases,**

❑ **Use known therapeutic or prevention interventions as testing bed,**

❑ **Implement optimized imaging protocols to co-clinical interventions to collect co-clinical images,**

❑ **Deliver a Web-Resource populated with all methods, protocols, tools and results by the 3rd quarter of yr-5.**
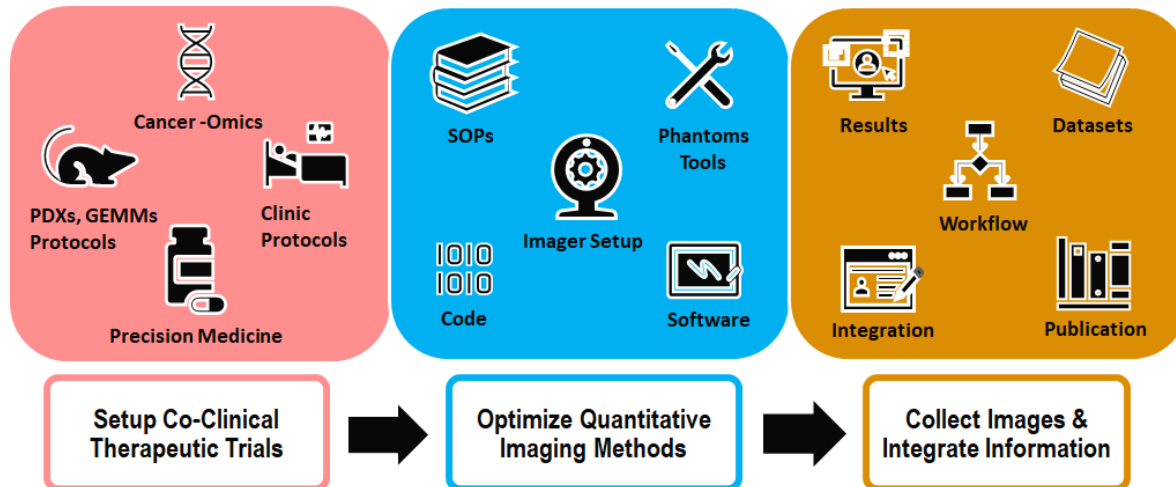

https://ncihub.org/groups/cirphub

CIRP Web-Resource

Workflow

Basic Required Content

❑ **Protocols**
- **Animal protocols**
- **Biology/Pathology/histopathology protocols**
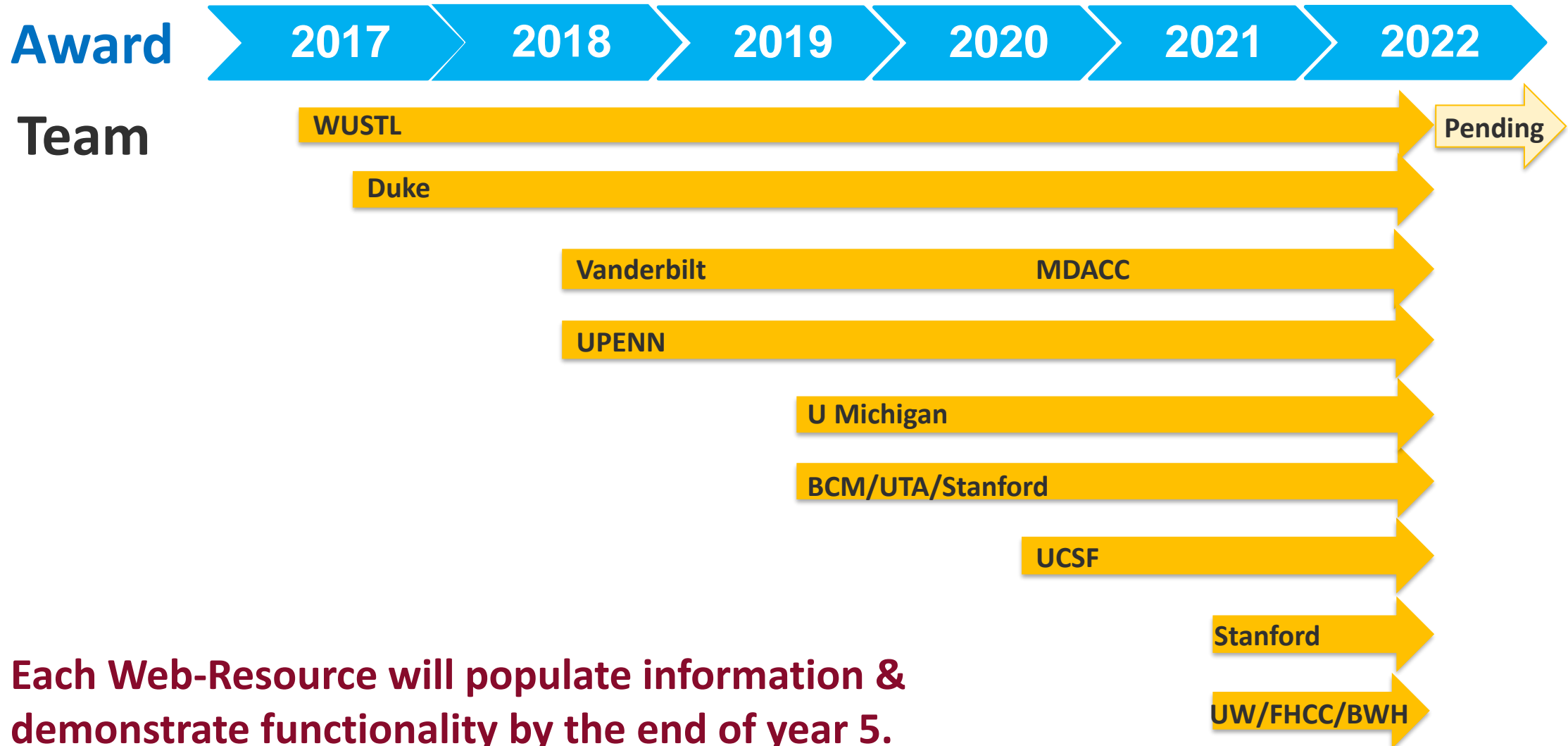- **Imaging protocols: QA/QC, PET, CT, MRI, etc.**

❑ **Methods**

❑ **Software**
- **Imaging process**
- **Image reconstruction**
- **Data analysis**

❑ **Representative Data that are correlated to each other (preclinical & clinical)**
- **Biology data**
- **Pathology Data**
- **Imaging data**

❑ **Results**

CIRP Web-Resources Are on the Way

Award

| 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |

Team

WUSTL — Pending

Duke

Vanderbilt — MDACC

UPENN

U Michigan

BCM/UTA/Stanford

UCSF

Stanford

UW/FHCC/BWH

Each Web-Resource will populate information & demonstrate functionality by the end of year 5.

CIRP Teams: Project Overview

Cancer Type	Diseases	Team	Patient Group		Tumor Stage		Mouse Model		Therapy		Quantitative Imaging				
			Adult	Pediatric	Primary	Metastatic	PDXs	GEMMs	Therapy	Combined	Anatomic	Metabolic	Cellular	Perfusion	Molecular
Hematology	Myelofibrosis	U Michigan	Y		Y			Y	Target		Y	Y			Y
Bone	Osteosarcoma	Stanford		Y	Y		Y		Immuno-therapy			Y			Y
Breast	Breast Cancer, TNBC	WUSTL	Y		Y		Y		Chemo-therapy		Y	Y	Y	Y	
	Breast Cancer, TNBC	BCM/UT/Stanford	Y		Y		Y		Chemo-therapy				Y	Y	
Colon	Colorectal Cancer	MDACC	Y		Y		Y		Target	Immuno-therapy		Y			Y
Lung	Lung Cancer, NSCLC	UW/FHCRC/BWH	Y		Y			Y	Immuno-therapy	Target	Y				
Muscle	Soft Tissue Sarcoma	Duke	Y		Y	Lung		Y	Immunotherapy	Radiation	Y		Y		
Pancreas	Pancreatic Cancer, PDA	UPENN	Y		Y			Y	Target			Y		Y	
Prostate	Prostate Metastatic cancer, SCNC	UCSF	Y		Y	Bone Liver	Y		Chemo-therapy		Y		Y	Y	Y

Cancer Issue: Therapeutic response, efficacy, failure and prediction, personalized treatment,

Disease: 8 cancer types (6 primary, 2 metastasis), 7 Adult diseases, 1 pediatric diseases,

Animal Model: 5 sites use PDXs, 4 sites use GEMMs,

Clinical Trial: 4 institutes on-going, 2 SPOREs, 1 CTEP, 1 R01, 1 Consortium; 8 Co-Clinical prospective, 1 matched pre-clinical prospective,

Therapy: 3 Chemotherapy, 2 target therapy, 2 target/immunotherapy, 1 immunotherapy, 1 immunotherapy/radiation therapy,
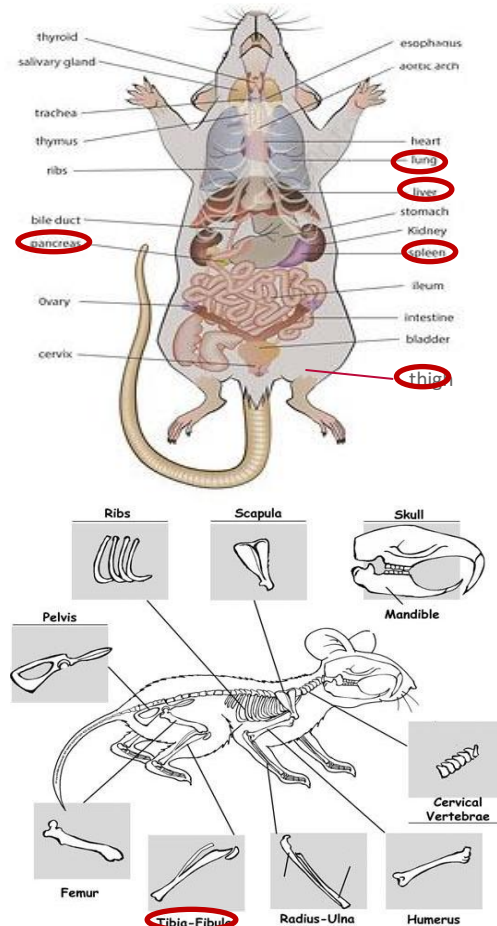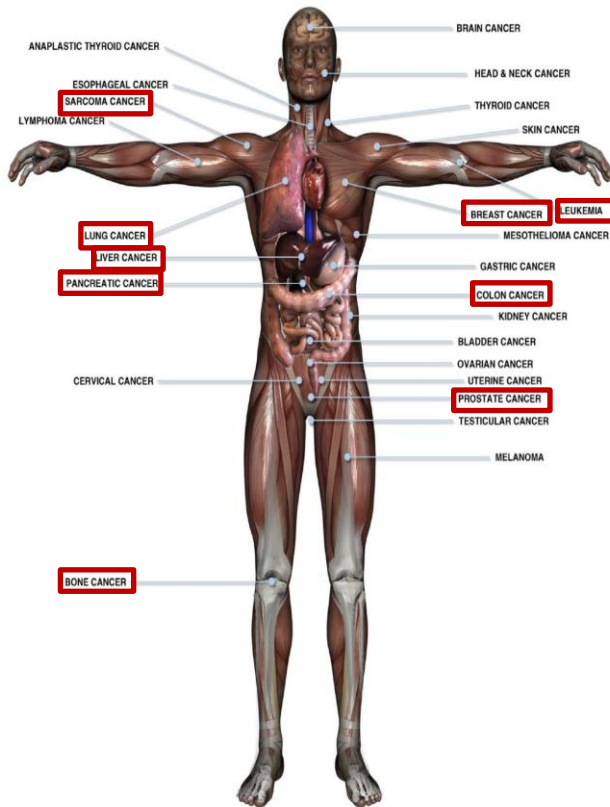
Imaging Methods: 1 CT, 2 PET, 5 MRI, 2 PET/MRI, anatomic, molecular, metabolic, cellular, perfusion, extendable to other diseases & therapies.

CIRP: Imaging Methods
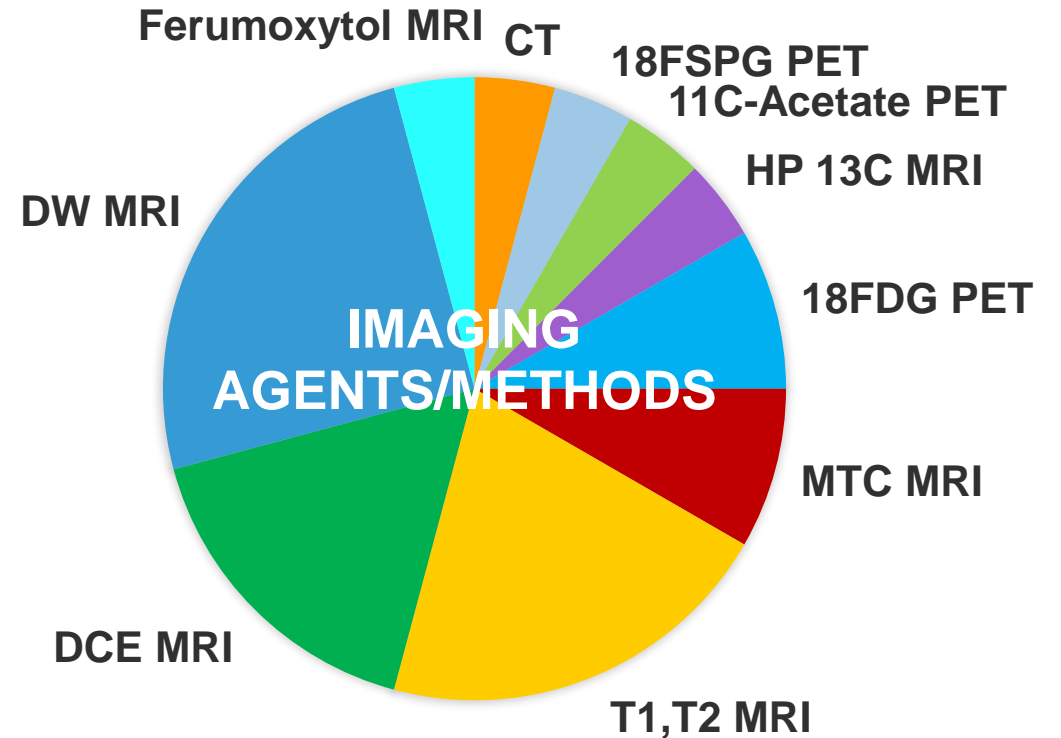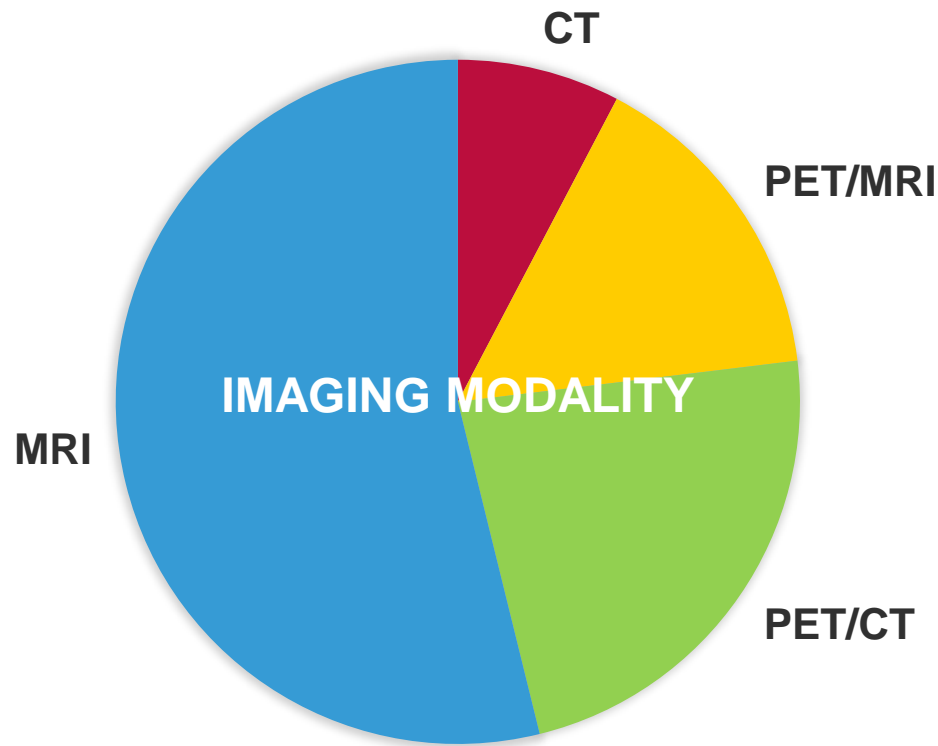
In vivo quantitative imaging of anatomy, function, metabolism, molecules, vascularity, cellularity.
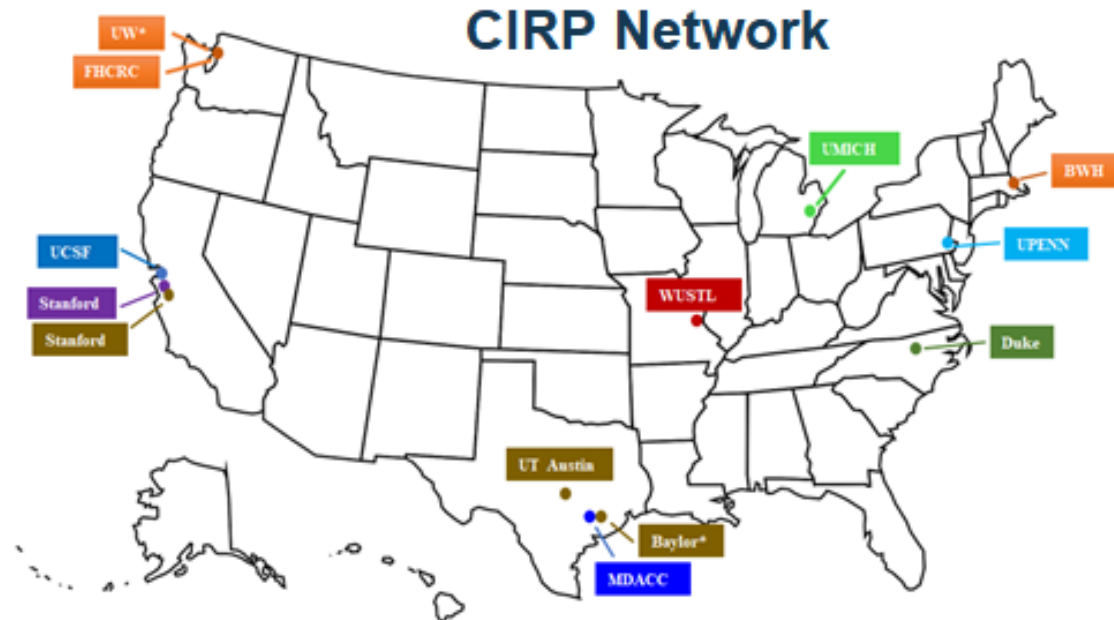
Cancers and Orthotopic Mouse Models Studied by CIRP

Potential of CIRP as Publicly Available Web-Resources

- ❑ Methodology to use animal models (PDXs or GEMMs) to recapitulate biological features of diseases,

- ❑ Protocols to detect dynamic spatio-temporal changes in tumor burdens at molecular, cellular, functional, physiological, anatomic level,

- ❑ Tools to generate quantitative, non-invasive, real time, longitudinal assessment for large cohort study,

- ❑ Strategies to inform clinical trials with pre-clinical study non-invasively and to bridge preclinical-clinical translational divide efficiently.

Web-resources Demonstrations: 7 teams

CIRP Network

Team, Awarded Time

WUSTL	May 2017
Duke	Sept 2017
MDACC	Sept 2018
UPENN	Sept 2018
UMich	Sept 2019
Baylor	Sept 2019
UCSF	Sept 2020

CIRP Resource Example: WUSTL

https://c2ir2.wustl.edu/
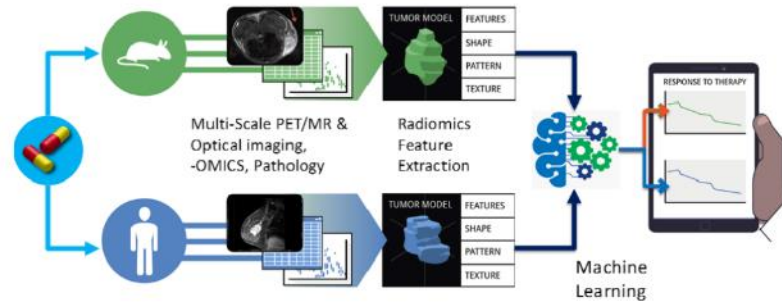
Resources
- ❑ **Animal Models**
- ❑ **Preclinical Phantoms for QA/QC**
- ❑ **SOPs for Animal Modeling**
- ❑ **SOPs for Scanner QA/QC**
- ❑ **Software/Code**
- ❑ **Datasets**
- ❑ **CIRP Resource Sharing Policy**
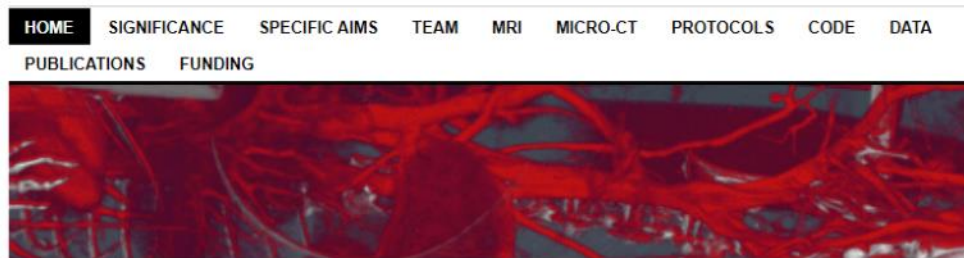
Disease: TNBC Breast Cancer

Selected publications

- ❑ X. Ge, et al., *Test–Retest Performance of a 1-Hour Multiparametric MR Image Acquisition Pipeline with Orthotopic Triple-Negative Breast Cancer Patient-Derived Tumor Xenografts*, Tomography, 2019, 5, 320-331,

- ❑ S. Roy, et al., *Optimal co-clinical radiomics: Sensitivity of radiomic features to tumour volume, image noise and resolution in co-clinical T1-weighted and T2-weighted magnetic resonance imaging*, EBioMedicine 59 (2020) 102963,

- ❑ M. A. Savaikar, et al., *Preclinical PERCIST and 25% of SUVmax Threshold: Precision Imaging of Response to Therapy in Co-clinical 18F-FDG PET Imaging of Triple-Negative Breast Cancer Patient–Derived Tumor Xenografts*, J Nucl Med 2020; 61:842–849,

- ❑ K. I. Shoghi, et al., *Co-Clinical Imaging Resource Program (CIRP): Bridging the Translational Divide to Advance Precision Medicine*, Tomography, 2020, 6, 273-287,

- ❑ K. Dutta, et al., *Deep Learning Segmentation of Triple-Negative Breast Cancer (TNBC) Patient Derived Tumor Xenograft (PDX) and Sensitivity of Radiomic Pipeline to Tumor Probability Boundary*, Cancers 2021, 13, 3795.

- ❑ S. Roy, et al., *Co-clinical FDG-PET radiomic signature in predicting response to neoadjuvant chemotherapy in triple-negative breast cancer, European Journal of Nuclear Medicine and Molecular Imaging*, 2021, https://doi.org/10.1007/s00259-021-05489-8.

CIRP Resource Example: Duke
https://sites.duke.edu/pcqiba/

The Duke Preclinical Research Resources for Quantitative Imaging Biomarkers

Duke Radiology

HOME | SIGNIFICANCE | SPECIFIC AIMS | TEAM | MRI | MICRO-CT | PROTOCOLS | CODE | DATA
PUBLICATIONS | FUNDING

Resources
☐ **MRI**
☐ **Micro-CT**
☐ **Protocols**
☐ **Code**
☐ **Data**

Disease: Soft Tissue Sarcoma with Lung Metastasis

Selected publications

☐ S. J. Blocker, et al., *Bridging the translational gap: Implementation of multimodal small animal imaging strategies for tumor burden assessment in a co-clinical trial*, PLoS ONE 14(4): e0207555, 2019

☐ S. J. Blocker, et al., *The impact of respiratory gating on improving volume measurement of murine lung tumors in micro-CT imaging*, PLoS ONE 15(2): e0225019, 2020

☐ M. D. Holbrook, et al., *MRI-Based Deep Learning Segmentation and Radiomics of Sarcoma in Mice,* Tomography, 2020, 6, 23–33,

☐ A. J. Wisdom, et al., *Single cell analysis reveals distinct immune landscapes in transplant and primary sarcomas that determine response or resistance to immunotherapy*, NATURE COMMUNICATIONS, 6410 (2020),

☐ M. D. HolBrook, et al., *Detection of Lung Nodules in Micro-CT Imaging Using Deep Learning*, Tomography 2021, 7, 358–372.

☐ Blocker, S. et al., *Ex Vivo MR Histology and Cytometric Feature Mapping Connect Three-dimensional in Vivo MR Images to Two dimensional Histopathologic Images of Murine Sarcomas*, Radiology: Imaging Cancer 2021; 3(3): e200103.

CIRPHub: Central Hub links to Individual Resources
https://nciphub.org/groups/cirphub

- ❏ **Teams:** abstracts of CIRP projects
- ❏ **Team Websites:** links to individual CIRP web-resource
- ❏ **Activities:** meeting agenda and program slides
- ❏ **Selected publications:** CIRP papers

CIRP Working Groups

❑ **Animal Model & Co-Clinical Trial (AMCT) WG:**

  Cancer issues and Unmet Needs
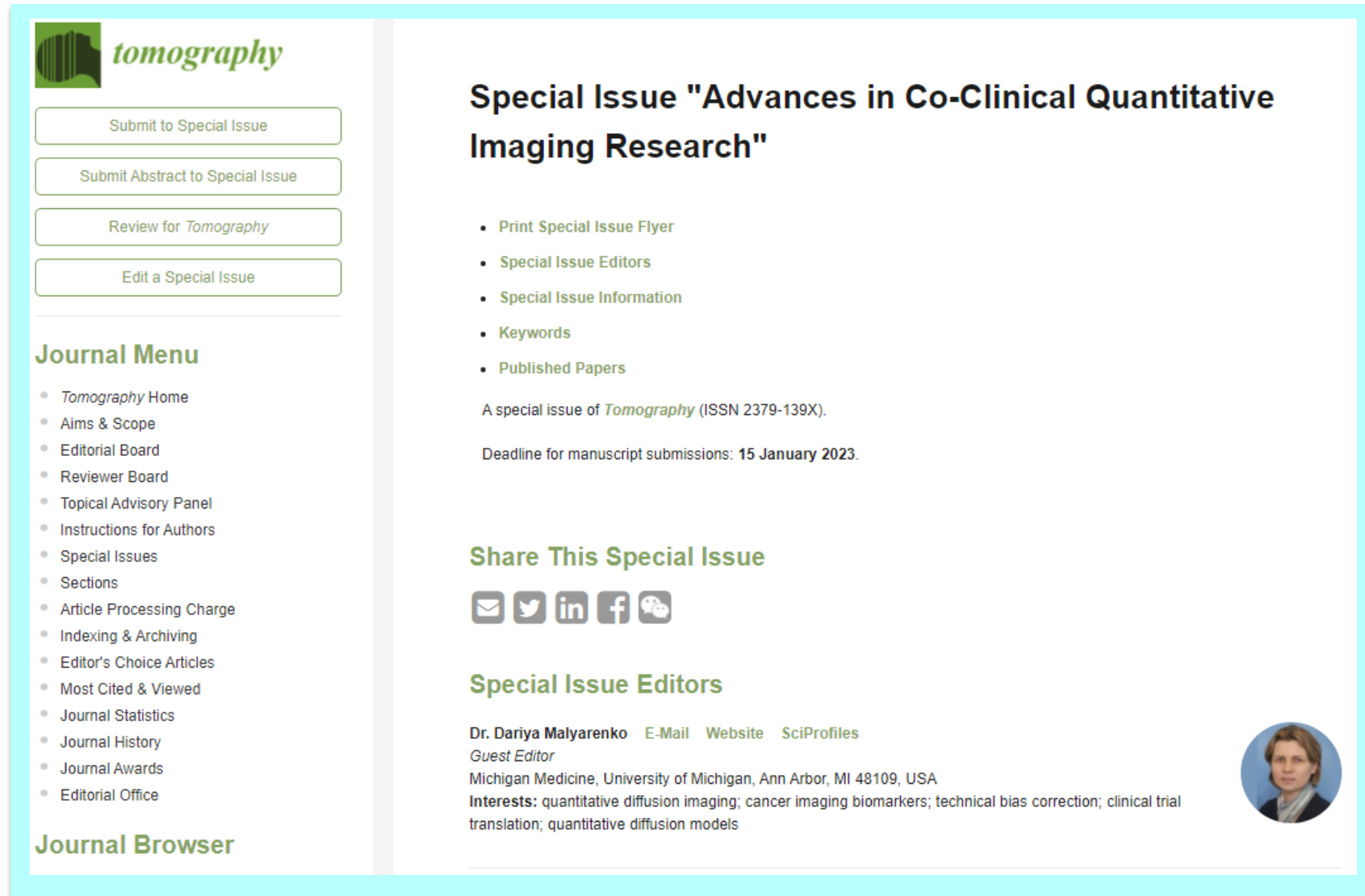
❑ **Imaging Acquisition & Data Process (IADP) WG:**

  Standardization & Metrology

❑ **Informatics & Outreach (IMOR) WG:**

  Metadata & Interoperability

CIRP Network: A special issue is coming

https://www.mdpi.com/journal/tomography/special_issues/AQCCIR

CIRP Outreach & Dissemination
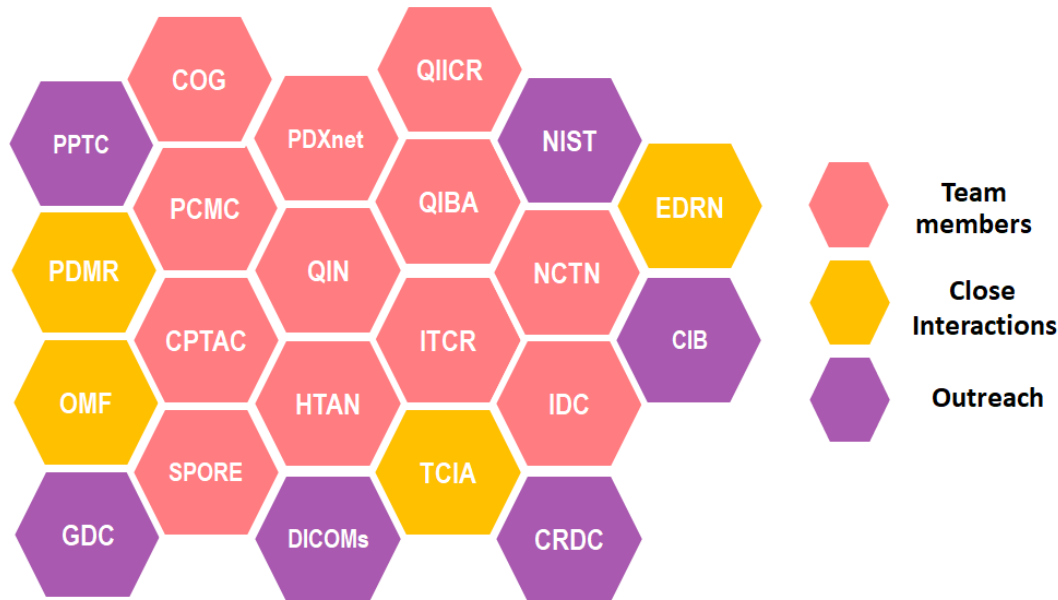
- ❏ **CIRP Annual Meeting: Open to public,**
- ❏ **Outside speakers invited by the CIRP working groups,**
- ❏ **CIRP organizes sessions at scientific meetings or conferences,**
- ❏ **CIRP investigators present at scientific meetings,**
- ❏ **CIRP invites outside investigators as associate members,**
- ❏ **CIRP Hub as central hub (https://nciphub.org/groups/cirphub),**
- ❏ **Individual CIRP Web-resources.**

Questions?

This set of slides will be available at
https://ncihub.org/groups/cirphub

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