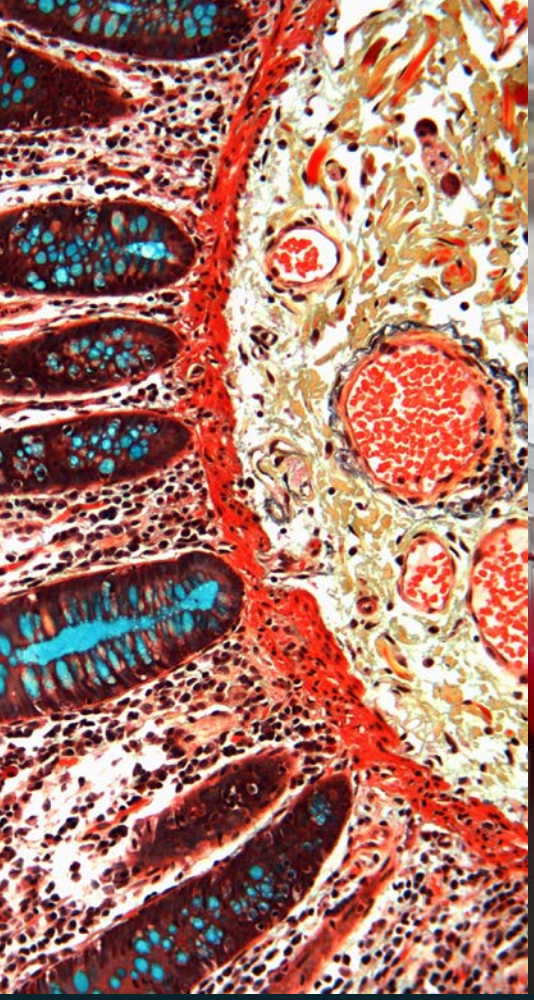
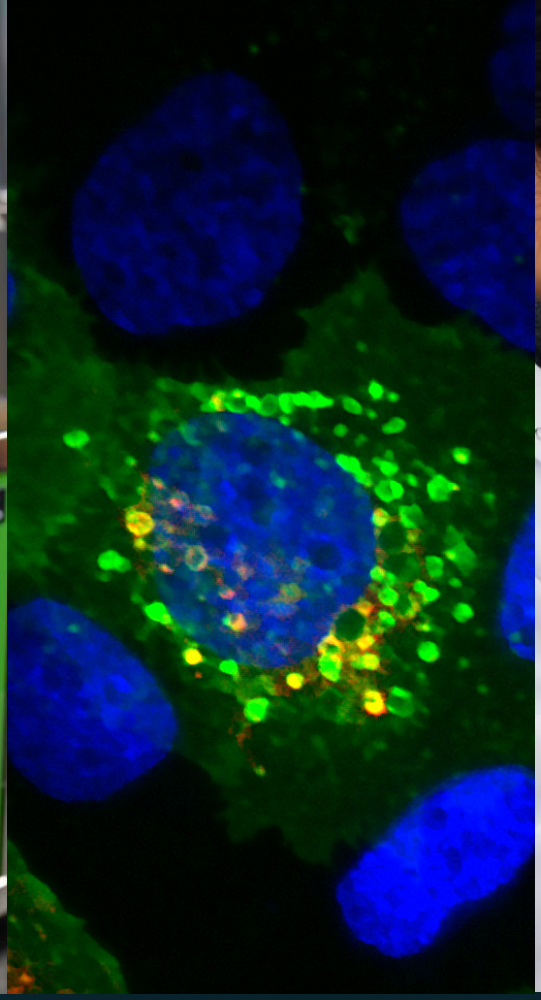




BRI External Core Labs

Experts in immunology

Explore our core lab shared resources: advancing science to improve human health

Benaroya Research Institute
Virginia Mason Franciscan Health

ptic neuritis rheumatoid arthritis juvenile idiopathic arthritis complex regional pain syndrome Ig
asculitis amyloidosis bullous pemphigoid Hashimoto's disease hidradenitis suppurativa chron
yme disease inclusion body myositis allergies sarcoidosis interstitial cystitis IgA nephropat
iff-person syndrome vasculitis Behcet's disease autoimmune polyglandular syndrome type
soriatic arthritis retroperitoneal fibrosis autoimmune orchitis autoimmune pancreatitis sympathet
phthalmia relapsing polychondritis Raynaud's disease PANDAS syndrome acquired hemophil
ndifferentiated connective tissue disease multifocal motor neuropathy psoriasis lupus paroxysm
octurnal hemoglobinuria Vogt-Koyanagi-Harada disease leukocytoclastic vasculitis autoimmu
ngioedema ankylosing spondylitis glomerulonephritis narcolepsy transverse myelitis polyarteri

Visit BRI's facility profile on the CoreMarketplace by scanning the QR code to the left or visiting bri-news.short.gy/OEu5BE.

benaroyaresearch.org

Table of Contents

About Benaroya Research Institute

Image: exterior, Benaroya Research Institute

At Benaroya Research Institute, we study the immune system and the wide range of diseases that affect it — including autoimmune diseases, allergies, asthma and cancer. We create detailed pictures of the immune system in health and disease, aiming to understand how disorders start and how to rebalance the immune system back to health.

As a nonprofit research institute within Virginia Mason Franciscan Health, we collaborate with doctors and patients to accelerate the path from innovative lab discoveries to life-changing patient care.

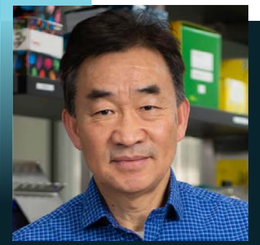
OUR MISSION	Advance the science to predict, prevent, reverse and cure diseases of the immune system
OUR VISION	A healthy immune system for everyone
OUR MOTIVATION	Immunology to change lives
OUR APPROACH	Together we discover
OUR IDENTITY	World leaders in human immunology

Business Development at BRI

Benaroya Research Institute (BRI) collaborates with external organizations worldwide, such as life science research institutions and pharmaceutical and biotechnology companies, to provide access to our tools, technologies and expertise. This includes partnership in the conduction of clinical trials and mechanistic studies, usage of advanced scientific equipment and biological samples from our biorepositories, and more.

Our business development team oversees our intellectual property portfolio, research collaborations, technology licensing, and material transfers as well as reviews all related agreements and contracts necessary to facilitate these activities.

> **To learn more about opportunities to collaborate with BRI, please contact our business development team via email at bizdev@benaroyaresearch.org. We look forward to working with you!**



Bolong Cao, PhD, MBA

Chief of business development, BRI

Dr. Cao joined BRI's business development team in 2011 and has served in his current role as chief of business development since 2023. Previously, Dr. Cao has worked with the University of Washington, Cerep, and Molecumetics. He holds a doctorate in chemistry and structural biology and a Master of Business Administration from the University of Washington.

Laurie Sheahan

Business development associate, BRI

Laurie has been a member of BRI's business development team since 2020. Previously, she has served in financial and operations roles across biotechnology, manufacturing, and software as a service (SaaS) start-ups. Laurie holds a bachelor's degree in mathematics.

BRI Biorepositories

Email contact: bizdev@benaroyaresearch.org

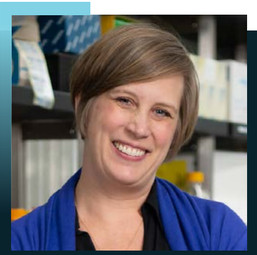
BRI is home to 11 vigorously maintained biorepositories containing blood and tissue samples donated by people with and without immune-mediated diseases. We employ careful and consistent sample processing and storage protocols to ensure sample integrity, enabling investigators to gather as much data as possible from each and every sample.

Our specimens allow scientists to advance research that is providing insights into the causes of immune-mediated diseases; making progress toward predicting, preventing, reversing and curing these conditions; and informing better diagnostic and treatment options for patients living with them.

Contact our business development team today to learn more about opportunities to collaborate.

How do our biorepositories work?

1. Bio-specimens are collected from donors living with and without immune-mediated diseases.
2. Samples and health information are coded with a number for confidentiality.
3. Samples are kept whole or separated into their building blocks (i.e., serum, plasma, PBMCs, DNA, RNA, cells, molecules).
4. Samples are readily available to researchers interested in collaborative projects.
5. Samples help scientists work quickly to make discoveries that have the potential to improve patient care.



Cate Speake, PhD

Director and associate member, BRI Center for Interventional Immunology

Dr. Speake, alongside BRI's Sandra Lord, MD, oversees the processing and storage of the hundreds of thousands of samples currently stored within BRI's biorepositories. She also leads BRI's Experimental Medicine Unit, which conducts small clinical trials to investigate the mechanistic drivers of type 1 diabetes (T1D). Using her expertise in analyzing large datasets, Dr. Speake's work is focused on translating findings from the laboratory to help answer clinical questions. Many of her studies have focused on novel methods to identify biomarkers that predict T1D disease progression both before and after clinical diagnosis.

BRI's biorepositories:

Allergies and Asthma
Principal investigator: Rahool Davé, MD

Cancer
Principal investigator: Christopher Gault, MD, PhD

Down Syndrome
Principal investigator: Rebecca Partridge, MD

Gastrointestinal Disease
Principal investigator: James Lord, MD, PhD

Healthy Control
Principal investigators: Jane Buckner, MD, and Carla Greenbaum, MD

IgA Nephropathy
Principal investigator: Bernard Khor, MD, PhD

Neurologic Disease
Principal investigator: Mariko Kita, MD

Pulmonary Disease
Principal investigator: Carmen Mikacenic, MD

Rheumatic Disease
Principal investigators: Sarah Chung, MD, and Vivian Stone, MD

Type 1 Diabetes
Principal investigator: Sandra Lord, MD

Vaccine and Infectious Disease
Principal investigator: Uma Malhotra, MD

By the numbers:

330,000+
total samples

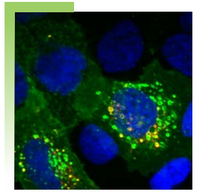
16,500+
active participants

2,000+
samples distributed annually to external collaborators

About BRI's Core Labs

Email contact: bizdev@benaroyaresearch.org

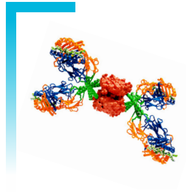
BRI's core labs support scientists both inside and outside our institute, have unique staff and technologies, and share roots in BRI's work to advance science to predict, prevent, reverse and cure diseases of the immune system:



Cell and Tissue Analysis Group

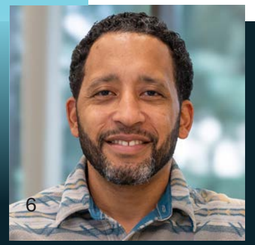
Genomics Core

Human Immunophenotyping Core



Protein and Tetramer Core

Animal Resources Core



Amir Figueroa

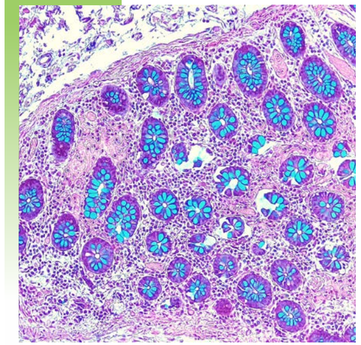
Director, BRI Immunology Shared Resources; manager, BRI Cell and Tissue Analysis Group

Amir joined BRI in January 2026, bringing experience from a Seattle-based biotech company and leading diagnostic and flow cytometry core facilities. He supports advanced technologies and core laboratory operations, helping scientists at BRI and beyond leverage these tools to advance discovery.

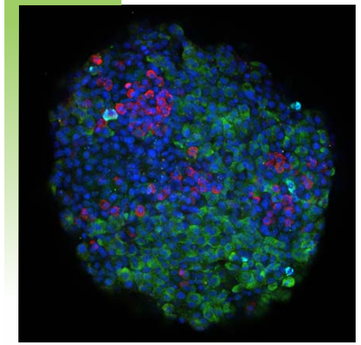
BRI Cell and Tissue Analysis Group

Email contact: cata-core@benaroyaresearch.org

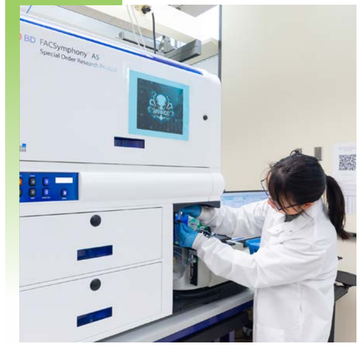
The BRI Cell and Tissue Analysis (CATA) Group provides investigators with consistent and dependable access to cutting-edge technologies. We offer the physical space and machines to carry out research projects as well as critical support through every step — from hands-on training to experiment design to data analysis:



Histology Core



Imaging Core



Flow Cytometry Core

Visit the BRI CATA Group facility on the CoreMarketplace by scanning the QR code to the left or visiting bri-news.short.gy/yuGKo9.

BRI CATA Group | Histology Core

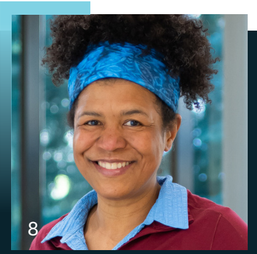
Email contact: cata-core@benaroyaresearch.org

The BRI Histology Core offers comprehensive services utilizing a suite of high-throughput automated equipment, including:

- Dye-based and immunohistochemical staining
  - Special stains
  - Immunohistochemistry
  - Immunofluorescence
- Tissue processing, infiltration, embedding and sectioning
- Tissue microarrays
- Spatial transcriptomics
- Whole slide imaging

Image (left): Movat Pentachrome HuGut

Image (right): intestinal structure and EpCAM protein (green) localization, highlighting epithelial cells along a mouse colon



Pamela Johnson, PhD

Manager, BRI Histology Core

With more than 25 years of histology experience, Dr. Johnson specializes in protocol development and emerging technologies. She and her team support projects ranging from a single slide to large-scale studies, tailoring services to meet research needs. Dr. Johnson has led BRI's Histology Core since 2014.

BRI CATA Group | Imaging Core

Email contact: cata-core@benaroyaresearch.org

Services

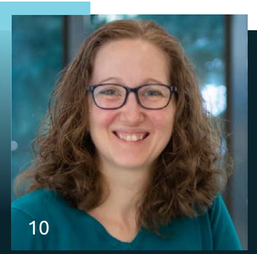
- Consultation on study design
- Full-service screening
- Microscopy training

Capabilities

- Image analysis, multiplexing imaging
- Three-dimensional imaging and high-throughput imaging

Equipment

- Molecular Devices ImageXpress HT.ai



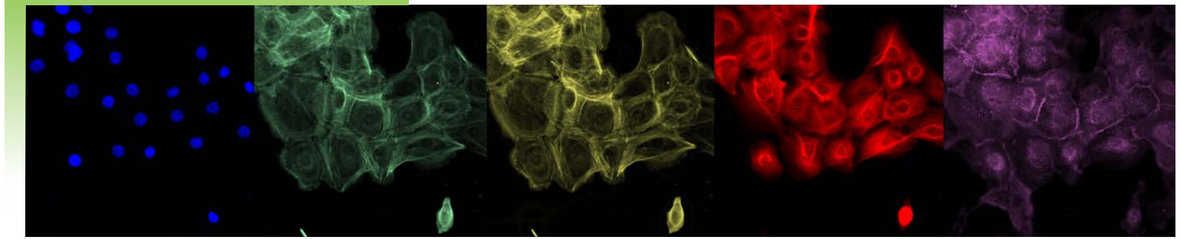
Caroline Stefani, PhD

Manager, BRI Imaging Core; research assistant member, BRI Center for Systems Immunology

Dr. Stefani is a pioneer in using virtual reality as a three-dimensional visualization tool for fluorescence images. She leverages her background in confocal microscopy, imaging-based screening and image analysis to keep the BRI Imaging Core at the forefront of advanced technologies.

Multiplex imaging

Image (below): taken using ImageXpress HT.ai 20X objective — keratinocytes stained for nucleus (blue), filamentous actin (green), phalloidin (yellow), mitochondria (red), and WGA (magenta)

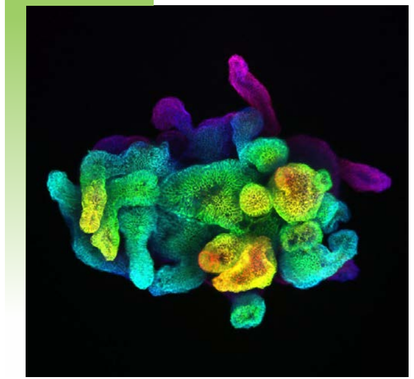


Molecular Devices ImageXpress HT.ai

Image (below): spinning desk confocal, plate reader, and seven lasers

Three-dimensional (3D) imaging

Image (below): mouse gut organoids stained for EpCAM — color represents 3D levels (Z-Stack) with a rainbow scale



BRI CATA Group | Flow Cytometry Core

Email contact: cata-core@benaroyaresearch.org

Resources in the BRI Flow Cytometry Core include multiple high-parameter analyzers and cell sorters. With a dedicated, highly-trained staff, our facility is well-positioned to offer a spectrum of support, from training external users on these technologies to full-service analysis and cell sorting.

Instrumentation

- Analyzers
  - › **BD FACSymphony** (x2)
  - › Cytek Aurora
  - › BD LSRFortessa
  - › BD FACSCanto
- Cell sorters
  - › **BD FACSDiscover S8**
  - › BD FACSAria Fusion

Image (above): dedicated room capable of BSL-2 sorting with enhanced practices

Consultation

- Panel and experiment design
- Troubleshooting

Training

- Introductory sessions to cutting-edge analysis and sorting platforms
- Educational opportunities and advanced technology seminars

Capabilities

- Independent, assisted and full-service use options
- High-parameter, traditional or spectral flow cytometry
- BSL2+ sorting, including coordination with the BRI Genomics Core to ensure special care of sensitive samples

Close proximity to and coordination with other BRI core labs ensures continuity of service as sorted cells are prepared for downstream applications, such as those within the BRI Imaging Core or BRI Genomics Core.

BRI Genomics Core

Email contact: genomics@benaroyaresearch.org

Visit the BRI Genomics Core facility on the CoreMarketplace by scanning the QR code to the left or visiting bri-news.short.gy/HNR7vR.

The BRI Genomics Core offers genomics analysis from sample processing through data generation. Whether you have one sample or hundreds, we can apply our expertise to assist in your experiment. We specialize in project design and workflow optimization, ensuring quality data is generated from every sample. In addition, we work closely with the BRI Bioinformatics Group, offering our clients access to cutting-edge analysis and visualization platforms.

Services

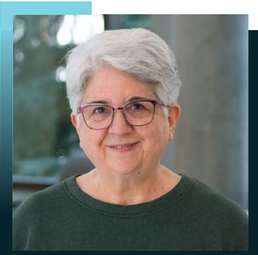
- **Library construction and sequencing** for profiling bulk populations or single cells; epigenetics and spatial transcriptomics
- **Nucleic acid extraction** and quality control

Capabilities

- **RNA sequencing** from as little as one nanogram of purified RNA or sorted bulk populations of 50-1000 cells; profiling of plate-sorted single cells, including V(D)J recombination
- **Single-cell profiling using 10x Genomics,** including gene expression, V(D)J recombination, cell surface proteins, and chromatin accessibility
- **Spatial transcriptomics**
- **ATAC-seq, CUT&RUN and CUT&Tag**

Equipment

- **Illumina sequencers**
  - NextSeq 2000: two sequencers with patterned flow cell technology; flexible flow cell sizes of 100M, 500M, 1300M or 1800M reads with XLEAP technology
  - MiSeq: 1M to 25M reads; up to 2x300bp
- **10x Genomics Chromium X**: live cells or fixed cells; new GEM-X chemistry



Vivian Gersuk, PhD
Manager, BRI Genomics Core

Dr. Gersuk brings a background of more than 30 years in molecular biology and immunology to her role as BRI's genomics core manager. She and her team are experienced in using cutting-edge approaches to generate data and advance your scientific aims.

BRI Bioinformatics Group

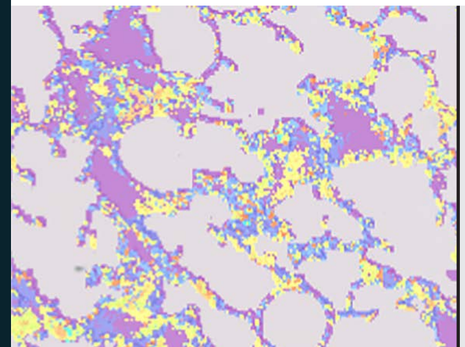
Email contact: hdeberg@benaroyaresearch.org

The BRI Bioinformatics Group partners with researchers to interpret complex, multidimensional data and drive high-impact research. As part of the BRI Center for Systems Immunology, the team supports the full research process — from study design and data collection to quality assessment, analysis and interpretation. With a team of 12 experts, BRI's bioinformatics group combines computational and scientific expertise to deliver rigorous, actionable insights.

Learn more about the BRI Bioinformatics Group by scanning the QR code to the left or visiting bri-news.short.gy/PQze0z.

Hannah DeBerg, PhD
Manager, BRI Bioinformatics Group

Dr. DeBerg leads the BRI Bioinformatics Group, partnering with researchers to design studies and interpret complex data, supporting high-impact research and data management.



Spatial Transcriptomics at BRI

Spatial transcriptomics enables high-resolution mapping of gene expression within intact tissue, preserving spatial context at the cellular level. By integrating gene activity with tissue architecture, BRI scientists characterize cell populations and functional states, providing insight into immune-mediated disease.

Pictured left: lung alveoli (open, light-purple spaces) — structures where gas exchange occurs and where the immune system interfaces with the external environment. These regions contain diverse cell populations that shift with inflammation. Cells are visualized based on gene expression, enabling analysis of composition and changes in healthy versus inflamed tissue.

BRI Human Immunophenotyping Core

Email contact: hip-core@benaroyaresearch.org

The BRI Human Immunophenotyping (HIP) Core specializes in robust, reproducible assays for application to human samples. Our team offers a full spectrum of support, from guidance on study design and training on new technologies to execution, data analysis and interpretation, as well as expertise in human immunology, innovative assays, and state-of-the-art technology. We provide robust, high-parameter single-cell assays utilizing conventional, spectral and mass cytometry (CyTOF), which can be paired with sophisticated genomic and bioinformatic analyses through other BRI core labs.

Flow cytometry assays

- Immunophenotyping
- Functional assays
- Antigen-specific T and B cells
- Peripheral blood mononuclear cells (PBMC), whole blood, BAL, bone marrow
- Bespoke panels and assays

Data analysis and interpretation

CyTOF panels and instrument training and use

Short-term in vitro assays

- Proliferation
- Activation
- Cytokine secretion
- Antigen-specific cells
- Immune cell killing assays

Soluble factor quantification

- Enzyme-linked immunosorbent assay (ELISA)
- Multiplex technologies (Luminex)

Preparation for BRI Genomics Core

- Cell sorting/isolation
- In vitro stimulation
- CITE-seq labeling of cells
- Cell preservation for RNA-seq

Consultation on study design

- Experimental plan
- Panel development
- Analysis tools and approach

Alice Wiedeman, PhD

Manager, BRI Human Immunophenotyping Core

Dr. Wiedeman has studied the human immune system for nearly two decades, working with scientists across a range of fields and taking advantage of the latest technologies to develop innovative assays tailored to meet researchers' needs.

Examples of our cutting-edge work in immunology and commitment to robust assays:

Longitudinally Stable T Cell Function and Innate Immune Activation Distinguish Healthy Adult Immunotypes

Science Translational Medicine, 2025

Robust assays

Impact On In-Depth Immunophenotyping of Delay to Peripheral Blood Processing

Clinical and Experimental Immunology, 2024

42-Parameter Mass Cytometry Panel To Assess Cellular and Functional Phenotypes of Leukocytes in Bronchoalveolar Lavage of Rhesus Macaque

bioRxiv, 2024

Clinical trial mechanism

Phase I Clinical Trial of Islet Antigen-Specific Plasmid Co-Expressing Tolerogenic Proteins Demonstrates Safety in Adults With Type 1 Diabetes

Diabetes, 2026

Early Expansion of TIGIT+PD1+ Effector Memory CD4 T Cells via Agonistic Effect of Alefacept in New-Onset Type 1 Diabetes

The Journey of Immunology, 2025

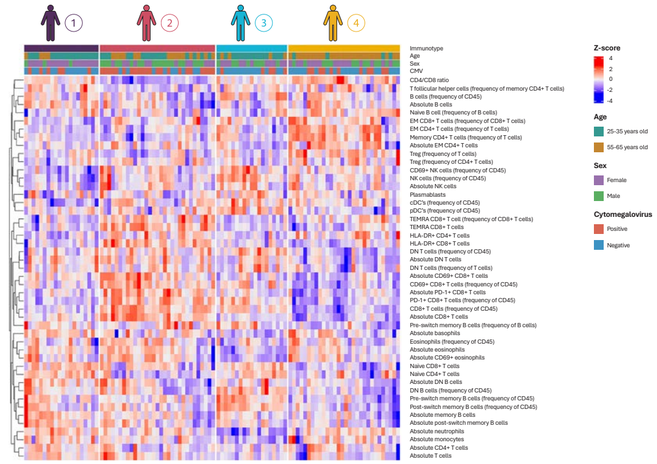
A First-In-Human, Open-Label Phase 1B and a Randomized, Double-Blind Phase 2A Clinical Trial in Recent-Onset Type 1 Diabetes With AG019 As Monotherapy and in Combination With Teplizumab

Diabetologia, 2023

The Sound Life Project

The Sound Life Project is a longitudinal study characterizing variation in healthy immune systems through deep immune profiling of well-annotated human samples. This dataset has enabled identification of distinct immunotypes and supports research into disease risk, biomarker discovery, and mechanisms underlying immune-mediated diseases.

The BRI HIP Core generated high-dimensional cytometry data from 100 participants across 1,000 longitudinal visits. This consistency and data quality were critical in enabling the visualization below and identifying subtle immune differences that define four distinct immunotypes (1, 2, 3, 4), revealing key patterns in immune system variation.



Science Translational Medicine, 2025

Visit the BRI Human Immunophenotyping Core facility on the CoreMarketplace by scanning the QR code to the left or visiting bri-news.short.gy/Hb0Ooo.

BRI Protein and Tetramer Core

Email contact: tetramercore@benaroyaresearch.org

The BRI Protein and Tetramer Core provides expertise in the development and production of HLA proteins, tetramers, antibodies, and other custom protein reagents to support scholarly and commercial research. Founded in 2001, the core builds on longstanding leadership in HLA class II tetramer technology to enable detection, characterization and isolation of epitope-specific T cells across a range of applications, including autoimmunity, infectious disease, allergy and asthma research.

What we offer:

Monomers/tetramers

- BRI's William Kwok, PhD, was the first investigator to report the development of an HLA class II tetramer
- HLA-DR, HLA-DP and HLA-DQ reagents for CD4+ T cells
- Custom peptide-loaded tetramers on demand

Antibodies

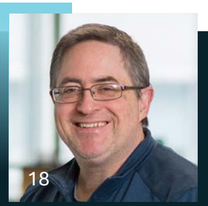
- Functional-grade antibodies (anti-DR, anti-DQ, anti-HLA-A, B, C
- For assays and HLA/peptide complex isolation
- Other antibodies upon request

Peptide-binding assays:

- Because the HLA class II proteins we produce are "empty," these monomers can be used in competition assays to measure the binding of putative epitopes to HLA class II proteins.

Rapid epitope discovery

- Leveraging the workflows we developed through multiple NIAID large-scale epitope discovery contracts, we are positioned to define HLA-restricted epitopes for high-interest antigens across a wide range of disease areas.

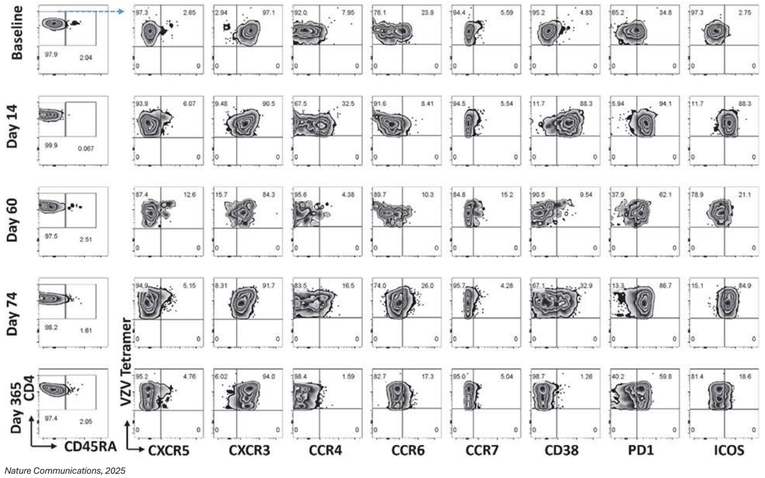


Eddie James, PhD

Director, BRI Protein and Tetramer Core; associate member, BRI Center for Translational Immunology

Dr. James leads the BRI Protein and Tetramer Core, overseeing the development of HLA proteins, tetramers, antibodies and custom reagents that enable detection and characterization of epitope-specific T cells and support discovery, biomarker development and translational research.

Longitudinal Single Cell Profiling of Epitope Specific Memory CD4+ T Cell Responses to Recombinant Zoster Vaccine



Nature Communications, 2025

Representative fluorescence-activated cell sorting analysis on varicella-zoster virus glycoprotein-E-specific CD4+ T cells by surface staining of CD45RA, CXCR5, CXCR3, CCR4, CCR6, CCR7, CD38, PD-1 and ICOS on CD4+CD154+Tetramer (DR0401/gE280-299)+ cells obtained from donor one at days zero (baseline), 14, 60, 74 and 365 post-first dose of Shingrix (second dose was administered after sample collection at day 60). TheCD154(PE)+Tetramer(PE-Cy7 or PE-Dazzle 594)+ cells were enriched by anti-PE MicroBeads and MS column then stained with other surface antibodies described above before flow cytometry analyses and sorting.

COMING SOON: second-generation tetramers:

Second-generation tetramers: building on pioneering work by Sugata et al. (Nature Biotechnology, 2021), the BRI Protein and Tetramer Core is poised to announce the release of new second generation HLA Class II tetramer reagents at the 2026 Immunology of Diabetes Society Congress in Brisbane. Using these reagents, we've observed a 20-50-fold increase in our ability to detect autoreactive T cells.

Examples of tetramers used in immunology research:

Longitudinal Single Cell Profiling of Epitope-Specific Memory CD4+ T Cell Responses to Recombinant Zoster Vaccine
Nature Communications, 2025

Technical Validation and Utility of an HLA Class II Tetramer Assay for Type 1 Diabetes: A Multicenter Study
The Journal of Clinical Endocrinology and Metabolism, 2024

Antigen-Specific T-Cell Frequency and Phenotype Mirrors Disease Activity in DRB1*04:04+ Rheumatoid Arthritis Patients
Clinical and Experimental Immunology, 2025

BRI Animal Resources Core

Email contact: aburich@benaroyaresearch.org

With expertise in breeding, handling, and general animal health needs, the BRI Animal Resources Core supports research activities while upholding the highest ethical standards of animal care. The program has been continually accredited by AAALAC International since 2004.

Our facility, staffed seven days per week, offers:

- Routine husbandry care.
- Basic colony management, including animal identification, tissue sample procurement for genotyping, and litter weaning.

Our state-of-the-art vivaria provide housing for pathogen-free mice and include:

- Individually-ventilated caging systems.
- Procedure and Animal Biosafety Level 2 (ABSL-2) rooms.
- New X-Rad320 x-ray irradiator with OptiMAX imaging.
- Portable isoflurane anesthetic machines.
- Electronically-monitored systems (e.g., temperature, humidity, room pressure differential, light).

Andrew Burich, DVM
Director, BRI Animal Resources Core

Dr. Burich has served as director of BRI's Animal Resources Core since 2005. As a full-time veterinarian, he provides oversight of the health and welfare of all animals housed at BRI, emergency care to our animals after hours and on holidays, and guidance and support to our researchers. He also holds an appointment as an affiliate instructor in the University of Washington (UW) Department of Comparative Medicine.

Previously, Dr. Burich worked for Oregon Health and Science University (OHSU) as a senior clinical veterinarian and assistant professor in the OHSU Department of Comparative Medicine. He completed a postdoctoral fellowship in laboratory animal medicine at the UW and holds a doctorate in veterinary medicine and bachelor's degree in zoology from the University of Wisconsin — Madison as well as a master's degree in comparative medicine from the UW.

benaroyaresearch.org

Visit BRI's facility profile on the CoreMarketplace by scanning the QR code to the left or visiting bri-news.short.gy/OEu5BE.

Why BRI?

About

1 in 17

Americans are living with a food allergy

United States Department of Agriculture, Food Safety and Inspection Service, 2024

About

1 in 14

Americans are living with asthma

United States Centers for Disease Control and Prevention, 2023

Up to

1 in 7

Americans are living with an autoimmune disease

National Institutes of Health, 2026

Over

2,100,000

Americans are estimated to be diagnosed with cancer in 2026

American Cancer Society, 2026

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