Fred Hutch
Cancer Center

Training Program in Infectious Diseases in the Immunocompromised Host

Program Brochure

Fred Hutchinson Cancer Center

OVERVIEW

ABOUT THE TRAINING PROGRAM

The Training Program in Infectious Diseases in the Immunocompromised Host has been established to train MD and PhD students to perform clinically relevant research in infectious diseases within the immunocompromised population.

THE RATIONALE

The overall burden of infectious diseases is on the rise. A 2007 WHO report warned that infectious diseases are spreading more rapidly than ever before, and new infectious diseases are being discovered at an unprecedented rate.

The proportion of the US population experiencing immunosuppression is also rising, partly attributed to the advancement of solid organ and hematopoietic stem cell transplantation techniques, therapies for autoimmune diseases, and immunosenescence (immunosuppression due to aging). Cancers and numerous immunologic disorders may also be linked to more specific or limited forms of immunocompromise, either by the immunosuppression caused directly by the disease or through the use of additional immunosuppressive treatments. This high-risk population experiences an increased risk of infectious diseases. Moreover, the outcomes of such infections and conditions, even those otherwise considered benign in healthy patients, can cause severe morbidity and mortality in the immunosuppressed.

This is a problem for which society demands effective and innovative solutions, and we aim to address it by providing the next generation of physician and postdoctoral scientists with specialized training in infectious diseases in immunocompromised hosts.

FRED HUTCHINSON CANCER CENTER

Fred Hutchinson Cancer Center (**Fred Hutch**) is a premier research institution in Seattle, Washington. Our interdisciplinary teams of scientists conduct research in the laboratory, at patient bedside, and in communities throughout the world to advance the prevention, early detection, and treatment of cancer and other diseases. Our researchers, including three Nobel laureates, bring a relentless pursuit of, and passion for, health knowledge and hope to their work and the world.

To accelerate the progress of clinical research, we are part of the Fred Hutchinson Cancer Center/University of Washington/Seattle Children's Cancer Consortium. This research and clinical collaboration enables our scientists to leverage each institution's strengths and develop premier research programs across many types of diseases. Furthermore, this consortium is among 56 National Cancer Institute-designated comprehensive cancer centers in the United States.

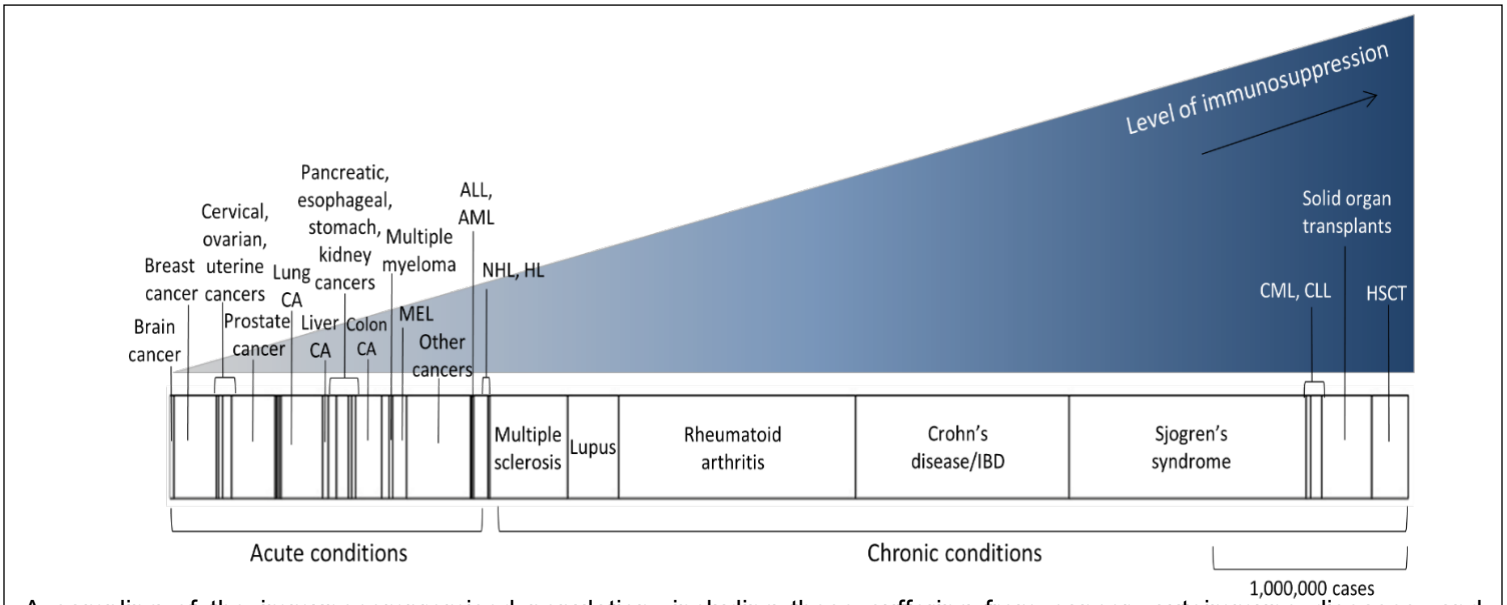
Our consortium partners' campuses are located within Seattle city limits and are linked by free shuttle services between campuses to promote interdisciplinary research and full access to consortium resources. The proximity of Fred Hutch, the University of Washington, Seattle Children's, both physically and institutionally, provides an amazing support system and plethora of resources for researchers.

INFECTIOUS DISEASE SCIENCES PROGRAM (IDS) OF THE VACCINE AND INFECTIOUS DISEASE DIVISION (VIDD)

INFECTIOUS DISEASE SCIENCES PROGRAM (IDS)

The Training Program in Infectious Diseases in the Immunocompromised Host is based in the Infectious Disease Sciences Program (**IDS**) of VIDD with close collaborations and interactions with other divisions as well as various departments and units within the University of Washington and Seattle Children's. Established in the 1980s at Fred Hutch, IDS has been home to many major innovative programs, including projects to study herpesvirus infections, respiratory viruses, invasive fungal disease, the microbiome and its role in human disease, HIV vaccine research, infection-related cancers, and infection control and hospital epidemiology.

Our researchers conduct interdisciplinary collaborative research and training at the highest level of excellence. The IDS Program has strong and long-standing collaborations and partnerships with multiple stakeholders, including patients and researchers, physicians and medical centers, data scientists and policy makers, industry sponsors, and federal agencies. IDS's mission is to advance knowledge of host-pathogen interactions and develop innovative management strategies for infectious diseases in immunocompromised and immunocompetent persons.



A sampling of the immunocompromised population, including those suffering from cancer, autoimmune diseases, and transplant patients. Segment size corresponding to each condition represents incidences per year in the US for acute conditions, and prevalence in the US for chronic conditions. Intensity of triangle color indicates severity of immunosuppression for each condition. Source: *Thomson Diseases Prevalence and Incidence Database*.

Map of Fred Hutchinson Cancer Center

Fred Hutch Cancer Center

1100 Fairview Ave. N. Seattle, WA 98109

Buildings

Arnold [M]
Public Health Sciences Division

Eastlake [E]
Vaccine and Infectious Disease Division

Hutchinson [C]
Human Biology Division

Minor [LM]
Clinical Research Center

South Lake Union Clinic
Outpatient Treatment

Steam Plant [S]
Laboratory / Office Space

Thomas [D]
Clinical Research Division

Weintraub [A/B]
Basic Sciences Division

Yale [J]
Administration

1208 Eastlake [T]
Laboratory

VACCINE AND INFECTIOUS DISEASE DIVISION (VIDD)

Fred Hutch is comprised of six scientific divisions: Basic Sciences, Clinical Research, Human Biology, Public Health Sciences, Radiation Oncology, Translational Science and Therapeutics, and Vaccine and Infectious Disease (**VIDD**); three Integrated Research Centers: Immunotherapy, Pathogen-Associated Malignancies, and Translational Data Science; the Hutchinson Institute for Cancer Outcomes research institute; five networks: Cancer Immunotherapy Trials Network, HIV Vaccine Trials Network, Seattle Translational Tumor Research, International Histocompatibility Working Group, and the Specimen Acquisition Network; and four interdisciplinary programs: Global Oncology, Fred Hutch Innovation Lab, Office of Community Outreach and

Engagement, and Population Health Colorectal Cancer Screening Program. VIDD's mission is to develop treatments and prevention strategies that counter infectious diseases throughout the world. Investigators working in VIDD research the human immune system, pathogens, and vaccines via statistical, clinical, and laboratory science. VIDD comprises several programs: Infectious Disease Sciences; Biostatistics, Bioinformatics and Epidemiology, which includes the Statistical Center for HIV and AIDS Research and Prevention (SCHARP); Immunology and Vaccine Development.

VIDD is home to one of the world's largest HIV research units and is the hub of the international HIV Vaccine Trials Network (HVTN), a global effort to develop and test a successful HIV vaccine. We have also been making a global impact with our prevention and treatment work by initiating collaborations with global partners such as the Uganda Cancer Institute, and the Cape Town HVTN Immunology Laboratory in South Africa, and the China CDC.

Program Description

THE GOAL

The mission of our training program is to develop the next generation of physician and postdoctoral scientists with expertise in infectious diseases in the immunocompromised host. Our goal is to provide rigorous and interdisciplinary training to foster innovative and collaborative research in infectious diseases in the transplant setting and other known and emerging areas of immunosuppression. We aim to train individuals who will use that expertise to advance knowledge and develop innovative strategies to prevent, treat and control these infections. Fred Hutch, with its variety of resources and established training success, is uniquely suited to this goal.

THE CURRICULUM

The core curriculum for the training program includes formal courses, didactic exercises and conferences that are important for all trainees regardless of their degree or research interests/projects. Some of the training is skills-based and covers key learning objectives, while others involve attendance and interactive research-focused group events.

CORE EXPECTATIONS

- Participation in core curriculum components.
- Development of critical skills in research methodologies relevant to an individual discipline or track.
- Development of skills in presenting research. All trainees are expected to present their research at local, national, and sometimes international meetings.
- Development of skills in scientific writing. A critical goal of this training program is to nurture skills in writing scientific papers, research proposals, and grant applications.

CORE CURRICULUM ELEMENTS

Orientation Course in Infections in Immunocompromised Hosts

All new trainees attend a one-day orientation course in which program faculty and track leaders address research in immunocompromised hosts, in addition to human subjects training. The course also introduces trainees to faculty members and to one another.

Annual Retreat on Infections in Immunocompromised Hosts

The program hosts an all-day research retreat. All training program faculty and trainees are encouraged to attend. MD and PhD scientists supported on the training grant (as well as others receiving training in the field, e.g., international scientists) present their on-going research for discussion. All presenters receive

immediate feedback on their presentations from at least two program faculty. The feedback and discussion are meant to further develop individual skills in presentation, data analysis, and interaction with other scientists.

Annual IDS and Virology Symposium

Physicians, scientists and trainees of Fred Hutch's IDS Program and the UW Virology Division come together for a joint symposium to share and celebrate research progress. Each T32 trainee gives an oral presentation on their research. IAC members also meet to discuss trainee progress and evaluate the training program.

Symposium on Infectious Diseases of the Immunocompromised Host

This symposium occurs biennially, and we hosted this event for the fourth time in May 2023. The two-day program features lectures by thought leaders in the field and early-career, rising star investigators. Trainees are encouraged to present their original research through short oral presentations or as part of our lively, interactive poster session. Networking opportunities include small group mentoring dinners.

Allergy and Infectious Disease Orientation Course for MD Fellows

MD fellows also attend a two-week orientation course covering a broad range of clinical ID topics at the beginning of their clinical years (which precedes the start of the research fellowship covered by this program).

Research in Progress Reporting and Participation

Each trainee will attend research in progress meetings with their mentors. In addition, trainees are required to present at least once every year their research progress at either an internal or external conference or lecture series that focuses on infections in the immunocompromised host.

Affinity Groups on Infectious Disease in the Immunocompromised Host and Mathematical Modeling

These groups meet throughout the year, featuring presentations by leading experts in these focus areas. Our T32 trainees and faculty are strongly encouraged to attend, and these events are open to all trainees, faculty, and staff in our scientific community.

Vaccine and Infectious Disease Division Seminar Series

This weekly seminar series at Fred Hutch features research presentations from faculty, scientists, senior fellows/postdocs, and guest speakers on a broad range of topics including infectious diseases, immunology and biostatistics.

Solid Organ Transplantation (SOT) Grand Rounds

The weekly seminars cover topics in SOT including infectious disease and immunology topics, featuring both local and external speakers.

Fred Hutch Research Ethics Education Program

Fred Hutch-based trainees (postdoctoral researchers, clinical fellows, and graduate students) are required, during their tenure at Fred Hutch, to attend six approved events. One of the six events must be a case study discussion group.

ITHS Clinical and Translational Boot Camp

This two-day course introduces ID fellows to the latest information about clinical and translational research, including observational studies and clinical trials. See more information here.

Targeted Lectures and Workshops on Key Skills and Methodologies

Trainees are strongly encouraged to attend these courses, which have been developed to build key skills that will provide a strong foundation for trainees' burgeoning research careers.

- *State-of-the-Art Statistical Methodology.* This course will introduce T32 trainees to state of- the-art methods, technologies, and analyses, with a focus on high-throughput and high-dimensional assays. It will be led by a T32 Senior Mentor and Fred Hutch Biostatistics Faculty member, Dr. Ollivier Hyrien.
- *Journal Club* on infections in the immunocompromised host. At this monthly forum, T32 faculty guide

our T32 trainees in discussing scientific articles relevant to their projects, with a specific focus on methods. Faculty provide supplementary information about rigorous methodology and analysis as needed. All faculty and trainees working in the field are invited. Our journal club takes place at faculty members' homes to foster strong relationships between training program faculty and trainees and also interactions among faculty.

- *Manuscript Writing Boot Camp.* Trainees are invited to this dedicated writing time, to make progress on and receive feedback on manuscripts. Senior program faculty as well as Jessica Lawler, Senior Writer/Editor with the IDS program, will also be available to provide individualized instruction and support.
- *Foundations in Biostatistics and Clinical Trials.* This course introduces Fred Hutch fellows to biostatistics and clinical trials. It is taught by Dr. Ted Gooley, T32 Supporting Mentor and Fred Hutch/UW Biostatistics Faculty.

Joint Opportunities with Related Programs

Our T32 program has teamed up with complementary UW/Fred Hutch training grant programs to host two, half-day joint retreats that feature research presentations by T32 recipient-trainees, aimed at exposing our trainees to key related fields of research. The Annual Oncology Research Training Retreat includes T32 and K12 recipient-trainees in medical oncology, gynecologic oncology, pediatric oncology, and infectious disease. Similarly, the Joint Retreat on Host Defense and Infectious Disease in the Immunocompromised Host (held in November 2019 and November 2020) includes T32 recipient-trainees in immunology, host-pathogen interactions, and infectious disease, as they relate to immunocompromised hosts.

Additionally, several linkages with the pediatric ID fellowship program have been developed to benefit both programs. Due to these linkages, both pediatric and adult ID fellows participate in most elements of the Core Curriculum, including orientation sessions, weekly conferences, an annual research retreat and journal clubs. Two pediatric faculty serve as mentors in this program (Dr. Englund, Dr. Waghmare).

Grant Writing

We strongly encourage and support grant writing at different levels: internal pilot grants, foundation and fellowship grants, loan repayment grants (if applicable), and, ultimately a career development (e.g., K award) project. Grant writing seminars are available at Fred Hutch and the UW, and senior mentors are available for input and grant review.

Didactic or Graduate Courses

MDs participating in **Tracks 1** will have the opportunity to obtain a master's degree in epidemiology at the UW. The UW-based Institute of Translational Health Sciences (ITHS) offers reduced tuition for Fred Hutch-based program participants. Alternatively, the Harvard School of Public Health offers a summer program in clinical effectiveness. This prestigious and intensive eight-week course focuses on the quantitative and analytical skills needed for a career in clinical research and is a shorter yet valuable alternative to a full degree program. Both options will be available to trainees in the appropriate tracks. Additional UW-based courses are available, and the selection will be individualized during training planning meetings.

Advanced Clinical Training in Immunocompromised Host ID (MD track only)

Although the main focus of the T32 is training in research, we believe that future medical leaders in immunocompromised ID must have superior clinical training that goes beyond the standard training obtained during the first clinical fellowship year. Therefore, we created the following opportunities to enhance clinical experience and skills. We believe that these limited clinical activities are critical and will be synergistic with the research goals and, ultimately, create both clinically and academically competent leaders. The clinical commitment will be carefully monitored during the regular program review process.

- Basic training part of ID fellowship: focus on inpatient immunocompromised ID.
- Participation in the outpatient clinics in HCT/cancer and SOT in T32 year 2 (ACGME ID Year 3).
- Participation in ID attending service as junior attending in T32 year 3 (ACGME ID Year 4) with co-attending of a senior, experienced immunocompromised host physician (two 14-day blocks in the last

year of training). This opportunity is aimed at solidifying the training in immunocompromised host ID medicine and continuing the trainee's career trajectory by functioning at the attending level (with primary responsibility and note signing) with concurrent co-attending by experienced program faculty. This provides a unique training experience and allows for increased salary supported by the clinical billing, thereby avoiding a career delay. This innovative model is facilitated by a title of Clinician/Researcher available in our system, which permits functioning in a hybrid fashion of a senior fellow and clinical attending (with billing privileges).

- Clinical transition meetings (bi-weekly): these meetings are case-based and open to all fellows and faculty with interest in the immunocompromised ID; they are also attended by pulmonologists.
- Clinical care conferences: a quarterly meeting that discusses ID management issues, reviews abstracts from national ID conferences, and reviews autopsy findings.
- Participation in infection control and stewardship meetings. There may also be opportunities for participation in quality improvement projects; many ID specialists will have to assume partial functions in these areas (even if they are not a dedicated leader in a particular hospital).

Career Development Opportunities

In addition to the above opportunities for developing skills in manuscript and grant writing, presenting their research, and broadening their scientific knowledge, trainees in our program are encouraged to take advantage of numerous career development resources at Fred Hutch and UW.

- The Fred Hutch Office of Scientific Career Development (OSCD) Director is available to have an informal career conversation with every new trainee.
- OSCD facilitates the Ivory Tower Quest Series (panels and talks on putting together application packets and interviewing for faculty positions), the Exploration Program for Industry Careers (EPIC, featuring half-day site visits to local biotech companies and networking opportunities), and the First Friday Series (seminars featuring scientific career options). They also provide examples of successful faculty applications.
- The Fred Hutch Student-Postdoc Advisory Committee (SPAC) Seminars and Workshops enhance the professional development of trainees so that they master the skills necessary for a successful career and learn about the types of careers that are available to them in both academia (including grant writing) and non- academic fields.
- UW career development resources include Fellows' Day, with a speaker panel on different career paths. We actively encourage trainees in year 3 to apply for independent positions in a research career pathway.

Facilities and Resources

The Fred Hutch merged (effective April 2022) with the Seattle Cancer Care Alliance, which provides access to a variety of resources for endeavoring researchers. These resources include, but are not limited to, the following:

CLINICAL

Clinical space is located at various locations across Seattle. As part of the Cancer Consortium, the Fred Hutch clinic resides in a seven-story, 309,000 square foot facility on campus. It houses outpatient clinics, multi- bed clinical trial units, radiation oncology, diagnostic imaging, clinical laboratory, infusion therapy, apheresis, minor procedures, physical therapy, pharmacy, patient support services, and faculty and administrative offices. Additionally, the inpatient unit at the University of Washington Medical Center - Montlake (UWMC) has 50 beds on the 7th and 8th floors.

Other affiliated sites and hospitals include UWMC and Seattle Children's Hospital. This unique network of hospitals gives fellows the opportunity to train under world-renowned physicians with diverse patient populations and access to world-class resources. Clinical training takes place at these locations.

The Infectious Disease clinics for HCT/cancer patients are held at the Fred Hutch clinic building while the SOT ID clinic is located at the UWMC-Montlake.

COMPARATIVE MEDICINE

Fred Hutch, along with its Consortium partnership organizations such as the UW, provides a broad variety of animal housing, veterinary, and research support services. The facility is fully accredited by the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) and complies with all United States Department of Agriculture (USDA), Public Health Service (PHS), Washington State and local area animal welfare regulations. Comprehensive animal husbandry services are provided for all vertebrate animals used in the Consortium's programs of research. All housing and use of vertebrate animals is done in Comparative Medicine's centralized facilities which occupy approximately 50,000 net square feet.

COMPUTER

Access and Availability

Most computer resources are fully integrated into the enterprise account management platform (Active Directory). User on/offboarding is largely automated and tied into Human Resources workflows with few extra setup steps required of FHCC researchers. Password age, length, and rotation are enforced by these enterprise systems.

Local Computing Resources

The Gizmo cluster is a capability cluster made up of 212 individual nodes with a total of 7,128 compute cores and more than 150 TB of main memory (RAM). These nodes are connected via 10Gb ethernet across a 100Gb Cisco network backbone to a fully redundant 5 petabyte Isilon storage cluster (primary storage) and a BeegFS[1] parallel file system (working storage).

Gizmo consists of three types of compute nodes:

- 3 Intel Xeon (Gold 6154, 3.0GHz) login nodes, each with 36 cores and 768 GB RAM
- 170 Intel Xeon (Gold 6254, 3.1 Ghz) nodes, each with 36 cores, 768 GB RAM, an NVIDIA RTX2080ti GPU, and 8TB of local NVMe disk
- 42 Intel Xeon (Gold 6146, 3.2 Ghz) nodes, each with 24 cores, an NVIDIA RTX1080 GPU, and 384 GB RAM

Each cluster node contains 1-8 TB local disk space which is used for non-shared temporary data. All of the cluster nodes are running the Ubuntu 18.04 LTS ("Bionic Beaver") distribution of the Linux operating system. Standard computational tools are installed on the head nodes and each worker node. These tools include current and legacy versions of R, the BioConductor[2] suite of R libraries, Python, as well as MPI processing capabilities (see "Software Services" below).

System configurations are managed using DevOps methodologies- source control and Chef configuration management- ensuring a documented and reproducible setup.
All FHCC research groups equally share these resources. The Slurm Workload Manager is used to manage workload and enforce fair sharing of HPC resources. The configuration of the workload manager is designed to ensure that all research groups can access a minimum number of resources at any time. In this cluster all

[1] BeeGFS. https://www.beegfs.io/content
[2] https://www.bioconductor.org/about/

principal investigators are given the same priority.

Cloud Computing Resources

Amazon Web Services (AWS) is used as the primary "Infrastructure as a Service" cloud platform. These services are covered under a Business Associates Agreement with AWS. This environment is fully audited and integrated with our Security Information and Event Management system.
This environment allows researchers to quickly provision computing, storage, and database resources with the ability to scale systems both vertically (scale-up) and horizontally (scale-out) easily to meet performance or capacity requirements.

Software Services

The majority of scientific software is managed using EasyBuild[3] which ensures reproducible deployments from source code. Most software is built by the Scientific Computing team and is accessed via the Lmod[4] environment management system. Use of Scientific Computing staff to build and deploy software is highly encouraged.

Data Storage Service

The Fast File storage service provides a high-performance file system. The service is based on Isilon file servers and accessed via SMB and NFS protocols. A cloud-based mirror of this file system provides backup and disaster recovery capability.

The Scratch File storage service provides high-performance working storage for intermediate and working copies of primary data. This storage is based on the parallel file system BeegFS and is primarily used as working space for intermediate data produced in bioinformatic workflows run on the compute cluster.

Economy Cloud provides access to AWS S3 storage services, including AWS Glacier for long-term archive. Managed secure data storage based on Amazon S3 is available to all investigators. All S3 buckets have mandatory encryption-at-rest and cloud trails access logging enabled. Only traffic using encryption in transit (HTTPS) can connect. This storage service is approved for highly confidential data. In addition to its use on-campus, this storage service is also commonly used to share and transfer data with collaborators.

Storage Security and Compliance

Economy Cloud (AWS S3) has been approved by the FHCC IT Information Security Office for the storage of PHI/PII data as it supports encryption-at-rest, encryption in transit, and access auditing.
Fast File Service supports encryption-at-rest and encryption in transit for some connections.

Extended storage services

Each principal investigator and member-track faculty is provided with 1TB of "Fast File" storage and 100TB of Economy storage. Usage beyond that amount is billed to the PI at the rates[5] of:

- $30 per TB/month for "Fast File"
- $3 per TB/month for "Economy Cloud"

Investigators are expected to request funds for data storage through their grant applications.

Network Connectivity

The network infrastructure consists of multiple local area networks connected to a 100G network backbone. The network is connected to the Internet through the Pacific Northwest GigaPop Network (PNWGP) and

[3] EasyBuild is developed by the High-Performance Computing team at Ghent University together with the members of the EasyBuild community, and is made available under the GNU General Public License (GPL) version 2 https://easybuild.io/
[4] https://www.tacc.utexas.edu/research-development/tacc-projects/lmod
[5] Rates and amounts current as of January 2023

Internet2 with redundant 10Gbit/s high-speed connections.

Staffing

Scientific Computing

The Scientific Computing group is staffed with 9 FTE and provides the following services to Fred Hutch research groups and shared resources:

- High-performance computing
- Computing support for Amazon Web Services
- Build of and support for scientific software
- General Linux/Unix support
- Software development support
- HPC and Linux/Unix training
- Data management assistance
- Data archiving

Information Security Office

The Information Security Office is staffed with 12 FTE. It offers services such as information security policies and standards development, risk assessment, security engineering, development of risk mitigation strategies and advocacy, education, and forensics.

System and Network Engineering

The Systems Engineering group is staffed with 14 FTE and maintains enterprise data storage systems and critical infrastructures such as Active Directory and the VMware virtualization platform. The Network Engineering group is staffed with 5 FTE and maintains the Fred Hutch 100G network backbone, data center networks, a high-performance firewall, remote access VPN, and 10G cloud connectivity.

Contact: Scientific Computing (scicomp@fredhutch.org)

OFFICE

Office space is provided by Fred Hutch to its divisions and programs. Faculty occupies offices, while fellows are provided workspace within close proximity to their mentors. There are over 90 conference rooms of varying sizes on campus with video conferencing capabilities in most of the larger conference facilities. Other amenities to campus buildings include secure file rooms and an on-site copy center.

SHARED RESOURCES AT THE FRED HUTCH

The Shared Resources (https://sharedresources.fredhutch.org/) at the Fred Hutch consist of facilities and laboratories that are made available for use to all Fred Hutch investigators as well as our consortium institutions, external academic and biotechnology community. The facilities give investigators the opportunity to augment their research with resources that would not otherwise be convenient or cost effective in each individual laboratory. The Fred Hutch's centralized facilities have proven to improve the feasibility and efficiency of performing clinical trials and permit more rapid translation of laboratory studies into clinical applications. These Shared Resources include:

- Antibody Technology
- Arnold Library
- Biostatistics
- Cellular Bioenergetics
- Cellular Imaging
- Clinical Research Support

- Collaborative Data Services
- Comparative Medicine
- Co-operative Center for Excellence in Hematology
- Electron Microscopy
- Epidemiology
- Experimental Histopathology
- Flow Cytometry
- Genomics & Bioinformatics
- Hutch Data Core
- Immune Monitoring
- Metabolomics
- Molecular Design and Therapeutics
- Nutrition Assessment
- NWBioSpecimen
- Preclinical Imaging
- Preclinical Modeling
- Prevention Center
- Proteomics & Metabolomics
- Specialized Pathology
- Specimen Processing & Research Cell Bank
- Therapeutic Products Program
- Translational Bioimaging Core
- Vector Production

The resources are available to trainees and serve the purpose of providing routine services for a variety of research activities, many of which are also focal points for technology dissemination and collaborative research. All resources are staffed by personnel with expertise specific to that facility.

Fred Hutch has two secured freezer facilities that occupy ~10,000 square feet on the campus. There is dedicated space for liquid nitrogen and scientific freezers for long-term specimen and sample storage. Since our last T32 grant submission, a second on-site secure facility was added to accommodate the specimen storage needs of Fred Hutch faculty. Both facilities and freezers are monitored 24 hours a day, 7 days a week by the Engineering Department.

Within Fred Hutch Shared Resources, the Research Cell Bank maintains the centralized transplant genomics repository of frozen blood cells and DNA derived from hematopoietic cell transplant patients, donors and family members dating back to the 1970s.The cell bank houses blood, cell and DNA material from more than 20,000 HCT recipients and donors.

Other Resources/Services

Within the IDS Program of VIDD, two IRB-approved biospecimen repositories exist, the Infectious Disease Biorepository and Microbiome Biorepository. The Infectious Disease Repository is open for use by all Fred Hutch investigators and houses over 385,000 specimens. Research utilizing the repository has led to four funded NIH grants and ten funded projects through foundations or institutional funding. For the Microbiome Repository, access is available to over 31,800 samples for Fred Hutch investigators.

An additional resource available to mentees within the IDS Program is centralized data and statistical support. Within the last three years, IDS has hired a statistical research associate and has dedicated data management support. The statistical research associate has over 15 years of experience working in the field of infectious disease research in the immunocompromised host. The statistical research associate provides guidance to trainees on how best to develop the parameters for collection and analyze their research data for abstracts, publications and grant submissions. The data management support works with the faculty and

statisticians to collect and retrieve data from EPIC (a clinical platform containing patient data from across our partners at the UW and SCH), Gateway (Fred Hutch internal research platform containing patient data dating back more than 30 years), clean data for statistical analysis, and develop RedCap databases for a variety of clinical research projects. These resources are available for trainees based in the IDS Program.

Fred Hutch has a Clinical Research Support (CRS) Administrative office that supports the center and consortium partners' mission to ensure the conduct of efficient, compliant and high-quality clinical research. CRS oversees the following resources to support on-going research: clinical trials website management, contracts and fiscal management, partner access, protocol review meeting coordination, quality management, research management data and training. In 2018 in conjunction with the CRS, Fred Hutch IT and our consortium partners at the UW and SCH, a Clinical Trials Management System (CTMS) called OnCore was developed and rolled out to our organizations. This system allows our organizations the ability to manage clinical trial portfolios more effectively.

The Arnold Library provides high quality, responsive services, and resources in support of Fred Hutch's research, education and patient care programs. The library's physical space houses study carrels with wireless Internet access, patron computers and the Shared Resources Computer Lab. This centralized resource encompasses subscription management for more than 30,000 eBooks and over 37,000 online journals as well as a variety of databases and web services. Librarians curate Fred Hutch researchers' profiles, provide center-wide tracking of scholarly publishing, support Center authors with NIH Public Access Policy compliance, manage the Shared Resources website, provide training and support for citation management tools like EndNote, provide reports and consultation on publication metrics, host a course guides system to support faculty instructors, manage the Fred Hutch history archive and administer several institutional repositories.

Our program training has three different yet finely integrated tracks that represent not only the individual strengths of the training faculty but also areas of innovation and unmet scientific and medical need. Senior faculty mentors with outstanding credentials within the unique area have been selected to be leaders of each track.

Track Descriptions

1) CLINICAL RESEARCH, INFECTION PREVENTION AND STEWARDSHIP EPIDEMIOLOGY, PATHOGEN DYNAMICS AND CLINICAL TRIALS

Michael Boeckh, Track Leaders

This track will provide trainees with excellent opportunities to develop skills in a broad range of areas related to the epidemiology of infections in HCT and SOT patients as well as moderately immunosuppressed patients, e.g., after a new diagnosis of cancer or those with autoimmune or chronic diseases requiring immunosuppressive treatment. The transplant ID programs at the Fred Hutch and UW have multiple and diverse ongoing projects that focus on the spectrum, risk factors, biomarkers/diagnostics, and outcomes of bacterial, viral, and fungal pathogens in HCT and SOT recipients. Through collaborations with faculty with expertise in mathematical modeling and biostatistics, this track will also provide trainees within depth experience in the relationship between pathogen and clinical outcomes and host determinants of pathogen dynamics, an area with important implications for defining the pathogenesis of infections in immunosuppressed hosts and in the design of interventional studies. Studies will be facilitated by a state-of-the-art molecular diagnostic laboratory directed by Keith Jerome and an unparalleled sample biorepository. This track will also provide trainees with excellent opportunities to develop skills in all aspects of observational and interventional trials. Trainees will obtain experience in trial design, patient recruitment and retention, implementation, monitoring, regulatory aspects, funding, and data analysis. This track also provides trainees with opportunities to study the epidemiology of healthcare associated infections as well as potential interventions aimed at reducing the risk of such infections in the immunocompromised host. This training program is one of the few existing programs aimed at expanding knowledge in the nascent field of infection control in these vulnerable patient populations for decades. Potential projects for trainees may focus on targeted organisms (e.g., multidrug-resistant organisms, respiratory viruses, etc.), targeted conditions (e.g., central line associated bloodstream infections), targeted interventions (e.g., chlorhexidine gluconate bathing, environmental decontamination, etc.), or addressing antimicrobial stewardship in these high-risk patients. Training will be obtained through attendance at weekly clinical trial meetings for ongoing trials, coursework in biostatistics and epidemiology, and attendance at scientific meetings. The breadth of faculty expertise and the long and distinguished past track record of successful clinical investigator trainees will ensure that future trainees are well prepared for independent careers as translational investigators. Trainees in this track are encouraged to pursue a Master in Epidemiology/Public Health degree.

2) IMMUNOLOGY/IMMUNOGENETICS

Geoffrey Hill, Track Leader

This track will conduct research of the specificity and function of human T cell responses to pathogens with the overall goal of understanding the biology of host-pathogen interactions. After initial pioneering human trials of adoptively transferred T cell clones to prevent cytomegalovirus (CMV) infection after allogeneic HCT, human trials of T cell therapy including the use of gene-modified T cells are now a strong research focus and area for training. These studies require the development of techniques for viral antigen discovery, and for isolation, expansion, characterization, engineering and reinfusion of T cells into patients. Additional studies are directed at defining intrinsic qualities of T cells that enable superior persistence and efficacy after adoptive transfer with specific emphasis on the identification of a novel memory T cell subset in humans that is distinct in phenotype, gene expression profile, response to homeostatic cytokines, and functional properties. The role of antibodies in control of viral disease (including CMV and respiratory viruses) is another area of research, energized by the work of Dr. Geoffrey Hill and an animal model for CMV now

available in his lab. Another focus of this track is to study factors associated with vaccine responses in the immunocompromised host. Immunocompromised hosts are often excluded from standard vaccinations during the time of maximum need; however, recent studies using novel CMV and varicella zoster virus (VZV) vaccines specifically target immunocompromised patients. This track also offers research opportunities to define pathogen-specific and immune reconstitution dynamics in immunosuppressed populations and to characterize and optimize vaccine responses using state of the art computational methodologies. Another area covered in this track is the genetic basis of infectious diseases. A unique cohort of 5,000 HCT recipients/ donors have undergone genotyping facilitates genome wide association studies (GWAS) of infectious phenotypes as well as associated validation experiments. Gene expression studies characterizing host signatures associated with progressive infectious diseases in immunocompromised hosts are another area for prospective trainees. Senior faculty with top credentials, computational expertise, and state-of-the-art technologies in labs and shared resources (including strong genomics facilities) support these studies.

3) MICROBIOME AND PATHOGENESIS

David Fredricks, Track Leader

This research track provides trainees with the opportunity to study the role of individual microbial pathogens in transplant outcomes and infectious complications in the immunocompromised host (e.g., CMV, respiratory viruses, *Clostridium difficile*, *Enterococcus faecalis*, *Aspergillus fumigatus*, and others). For example, postdoctoral fellows can investigate how CMV and HSV subvert the human immune response to establish lifelong infection, and the factors leading to reactivation of viral infection in the immunocompromised host. To facilitate studies, stool, mouth and skin samples from prospective cohort studies are available to trainees (as well as samples from our general repository). In addition, this track will provide a rich training environment for studying human-associated microbial communities (the indigenous microbiota) and their genes (the microbiome), with a focus on how bacterial communities at particular epithelial surfaces impact risk of infection and outcomes, such as graft-versus-host disease after HCT. Fred Hutch and the UW have a deep and diverse community of investigators studying aspects of the human microbiome and pathogenesis, providing many opportunities for rigorous laboratory-based investigation and career development. In 2017, Dr. Fredricks launched the Microbiome Research Initiative, which serves as an incubator for new scientific opportunities by galvanizing investigators who are pursuing microbiome studies, capitalizing on recent advances in the field and catalyzing nascent research on the microbiome that impacts cancer and infectious diseases.

Faculty

PROGRAM DIRECTOR

Michael Boeckh, MD, PhD, Head of the Infectious Disease Sciences Program, serves as Program Director for the training program As Program Director, Dr. Boeckh's responsibilities are to administer and oversee the training program, interact with NIAID and the different committees, oversee the integration of the training grant program into program activities to ensure the success of each trainee, and manage all other aspects of the training program.

ASSOCIATE DIRECTORS

Joshua Schiffer, MD, MSc, Professor at Fred Hutch/UW and Catherine Liu, MD, Professor at Fred Hutch/UW, serve as Associate Directors. Dr. Liu also serves as Director of the Antimicrobial Stewardship and Outpatient Parenteral Antimicrobial Therapy Programs at the Fred Hutch. As Associate Directors of the training program, Drs. Schiffer and Liu's responsibilities are participating in the selection process for trainees, creating mentorship committees; participating in the trainee evaluation process; participating in EAC and IAC meetings; curriculum planning and execution, and preparation of annual training grant progress reports.

EXTERNAL ADVISORY COMMITTEE

The External Advisory Committee (EAC) comprises four distinguished individuals (Kieren Marr, Nina Singh, David Snydman, & John Zaia) outside of our consortium organizations with strong credentials in both laboratory sciences and clinical research, expertise in obtaining NIH funding, and training the next generation of scientists.

INTERNAL ADVISORY COMMITTEE

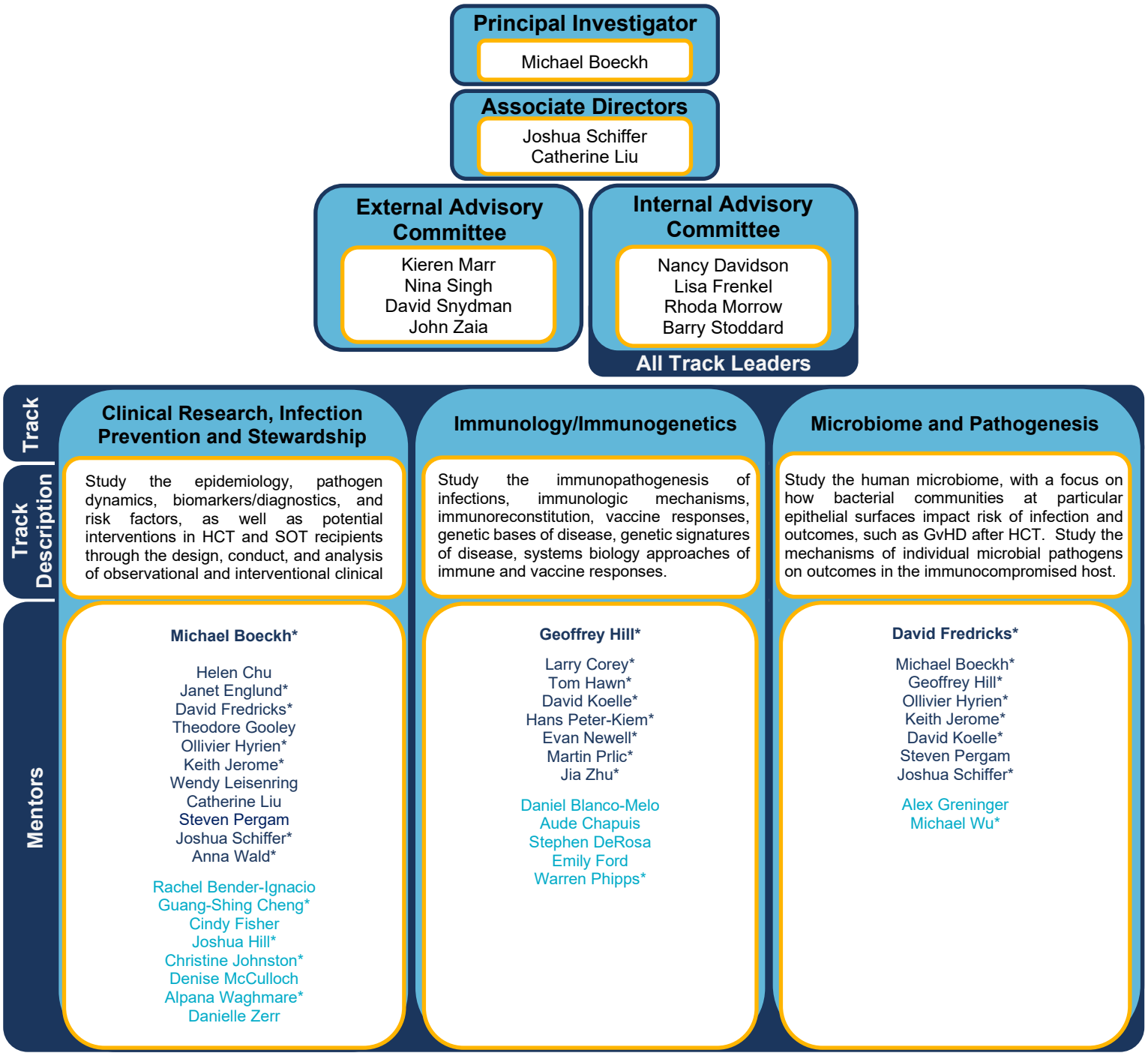
The Internal Advisory Committee (IAC) comprises all track leaders as well as distinguished individuals from inside of Fred Hutch and our consortium organizations with strong credentials in training, laboratory sciences and clinical research expertise as well as familiarity with the mission of our training program. The IAC committee members are Nancy Davidson, Lisa Frenkel, Rhoda Morrow, Barry Stoddard, David Fredricks, Geoffrey Hill, and Michael Boeckh.

SENIOR, JUNIOR AND SUPPORTING MENTORS

Training faculty with an especially strong expertise and track record in the fields of virology, molecular immunology, immunogenetics, microbial pathogenesis, epidemiology, clinical trials conduct and biostatics, will serve as mentors. Senior mentors were selected based upon the excellence of their research, ability to secure competitive extramural funding, and mentoring records. Junior mentors have less mentoring experience, and mentorship skills will be developed by pairing them with a senior and a supportive mentor. All have a unique set of skills and achievements for which they were selected to serve on the training faculty. We anticipate that some of the junior mentors will move into the senior mentor rank during the next five-year grant period.

This co-mentoring approach has been a highly successful concept in our experience. It will not only increase access to mentors for the trainees but also provide leadership and guidance as the younger faculty member develops mentoring skills. Overall, this approach will enrich the training experience of co-mentored trainees.

Training Program Organization



NOTE:
Bold indicates Track Leaders
* Mentors with Independent Federal Grant Support, e.g., NIH R- or U-Award
Navy text indicates full Professor
Teal text indicates Associate or Assistant Professor

Faculty Research Descriptions

Rachel Bender Ignacio, MD, MPH

Assistant Professor, Vaccine and Infectious Disease Division, Fred Hutch
Medical Director, COVID-19 Clinical Research Center, Fred Hutch
Assistant Professor, Allergy and Infectious Diseases, University of Washington
Adjunct Assistant Professor, Department of Epidemiology, University of Washington

Dr. Bender Ignacio is a physician-scientist who specializes in the treatment and prevention of infectious diseases, focusing on HIV/AIDS and COVID-19. With a background in epidemiology and global health, she explores co-infections with herpesviruses or tuberculosis among people with or at risk for HIV. Dr. Bender Ignacio also studies the development of cancers in people living with HIV and develops protocols for clinical care of people with HIV-related malignancies. Her translational research on the immune system includes research on inflammation, immune-cell and antibody responses to viral infections, and susceptibility to HIV, as well as studies on the establishment of latency in early HIV infection. She also is engaged in the design and operation of studies on ways to treat COVID-19 in its early stages. She leads the Hutch's COVID-19 Clinical Research Center and is a member of the HOPE Group (HIV Outcomes, Prevention, and Epidemiology).

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Daniel Blanco-Melo, PhD

Assistant Professor, Vaccine and Infectious Disease and Public Health Sciences Divisions, Fred Hutch

Dr. Daniel Blanco-Melo studies the biological mechanisms that animals have deployed throughout evolution to combat viral infections. He explores how changes in our antiviral strategies are driven by the constant struggle with past and current viral infections. The Blanco-Melo Lab's research is focused on the many complex biochemical processes that are activated within cells upon infection. His group studies important human viruses, such as influenza A and SARS-CoV-2, as well as ancient viral pathogens and the impact of those past agents on the evolution of animal immunity. He uses a combination of molecular biology, genetics and advanced computational techniques to better define and exploit our highly evolved antiviral responses, which can help in the design of drugs against both current and emerging viral threats.

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Michael Boeckh, MD, PhD

Professor, Vaccine and Infectious Disease and Clinical Research Divisions, Fred Hutch
Professor of Allergy and Infectious Diseases and Medicine, University of Washington
Head, Infectious Disease Sciences Program, Fred Hutch

Dr. Boeckh has been serving as the Program Head since 2012 and is an expert in infections that affect patients whose immune systems are weakened by illness, chemotherapy or blood stem cell transplantation. His research focuses on herpes viruses, respiratory viruses and the genetic factors that make individuals susceptible to them. His group conducts clinical trials testing ways to prevent and treat infection by common viruses such as cytomegalovirus, respiratory syncytial virus, parainfluenza virus and rhinovirus. In patients with weakened immunity, these can cause serious lung disease and death. The team also studies certain herpes viruses that can reactivate in cancer patients long after they were first infected. One such virus, HHV-6, is responsible for the common childhood rash roseola. It often flares up in patients who have received blood stem cell transplants. For them, the virus may raise the risk of central nervous system infections and graft-vs.-host disease, two frequent and potentially deadly complications. He is co-leader of the CovidWatch study, which sends home test kits to at-risk frontline workers, so researchers can track COVID-19 infections.

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Aude Chapuis, MD

Associate Professor, Program in Immunology, Clinical Research Division, Fred Hutch
John C. and Karyl Kay Hughes Endowed Chair, Fred Hutch
Associate Professor, Department of Medicine, Division of Hematology and Oncology, University of Washington

Dr. Aude Chapuis is an oncologist who sees patients in the Bone Marrow Transplant and Immunotherapy services. She leads a laboratory employing a translational pipeline to improve T cell receptor (TCR) gene-engineered immunotherapy. Their work spans target identification, generation of high-affinity TCR constructs and standard operating methods to translate these constructs into effective cell products for patients, clinical trial development and initiation, and sophisticated high dimensional immune-monitoring to maximize the information that can be derived from each treated patient. Current projects include T cell therapies against virally-driven tumors (targeting Merkel-cell polyoma virus antigens in Merkel cell carcinoma), solid tumors (targeting the MAGE-A1 cancer-testis antigen in non-small cell lung cancer, triple negative breast cancer, and bladder cancers; and targeting WT1 antigen in thoracic and gynecological cancers), and leukemias (targeting two WT1 epitopes in acute myeloid leukemia).

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Guang-Shing Cheng, MD

Associate Professor, Clinical Research Division, Fred Hutch
Associate Professor of Medicine, Division Pulmonary, Critical Care and Sleep Medicine, University of Washington
Affiliate Investigator, Vaccine and Infectious Diseases Division, Fred Hutch

Dr. Cheng is an Associate Professor at Fred Hutch and Associate Professor of Medicine at UW, as well as Affiliate Investigator in VIDD. As a trained pulmonary/critical care specialist, she has a research interest on the early detection of bronchiolitis obliterans syndrome, highly morbid and fatal complication of allogeneic hematopoietic cell transplantation, and the role that respiratory infections play in the BOS pathogenesis. Dr. Cheng is working to develop early detection and prevention strategies for HCT patients, including the use of wireless handheld spirometry monitoring, which may lead to earlier treatment. She is also involved in multicenter trials testing new drugs for the treatment of BOS and other lung diseases after HCT. She is investigating the relationship between respiratory viral infection and the development of lung disease in these patients.

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Helen Chu, MD, MPH

Professor of Allergy and Infectious Diseases and Medicine, University of Washington
Adjunct Professor, Department of Global Health and Department of Epidemiology, University of Washington

Dr. Helen Chu is focused on studying diagnostics, prevention and treatment strategies against influenza, RSV, SARS-CoV-2 and emerging respiratory viruses. Dr. Chu's lab conducts large-scale community-based studies of respiratory virus transmission, and clinical trials of vaccines and therapeutics. They evaluate immune correlates of protection against respiratory viruses in human cohort studies and describe mechanisms underlying maternal-fetal immunity,

particularly for vaccines given during pregnancy to protect the mother, fetus, and infant. Dr. Chu's current research studies focus on identifying strategies for control of the ongoing SARS-CoV-2 pandemic. She conducted community-based testing studies in households with young children and have conducted clinical trials of on-site diagnostics and treatment in homeless shelters, and surveillance studies for SARS-CoV-2 containment on an undergraduate college campus. Her lab established a longitudinal cohort of SARS-CoV-2 convalescent individuals for studies of long COVID and immune profiling of vaccination and infections, including with novel variants as they emerge.

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Lawrence Corey, MD

Past President and Director, Fred Hutch
Professor, Vaccine and Infectious Disease, Public Health Sciences, and Clinical Research Divisions, Fred Hutch
Professor of Medicine and Laboratory Medicine & Pathology; Lawrence Corey Endowed Chair in Medical Virology, University of Washington

Dr. Corey is a professor of VIDD at the Fred Hutch, professor in Laboratory Medicine & Pathology and Medicine at the UW and Past President and Director of Fred Hutch. In 1999, he reorganized the NIH HIV vaccine program to integrate and expedite the development of HIV vaccines globally, developing the Fred Hutch -based HIV Vaccine Trials Network (HVTN), for which he has been Co- PI and PI since its establishment. He is an esteemed academic investigator with continuous NIH funding since 1978. Over the past 35 years, he has mentored and trained over 60 postdoctoral fellows, a majority of whom now hold faculty positions in academia and industry. His main areas of expertise have been in human virology; particularly HIV infections, herpesvirus complications in HCT, and infectious disease related cancers. His major area of laboratory expertise is in mucosal immunology of chronic viral infections. The Corey lab focuses on the pathogenesis of chronic viral infections and host immune responses. This includes herpes simplex virus type 2 (HSV-2), HIV, and most recently SARS- CoV-2. The lab uses HSV as a model to study the tissue based immune system of the genital tract. Their studies indicate a diverse and unique set of tissue resident cells populate the genital tract and their work is devoted to identifying and understanding the role of these cells in disease pathogenesis. The ultimate goal for these projects is to develop immunotherapeutic methods to control subclinical HSV-2 reactivation and reduce the transmission to sexual partners. Their lab has also been interested in using genetically modified T cells as a form of adoptive therapy for viral infections. At the moment, this work is in the HIV system using the NHP model. CAR T cells and genetically introducing innate immune functions into T cells are the main approaches. The goal here is to use adoptive transfer of genetically engineered T

cells to traffic to and be effectors in lymphoid follicles with a goal to eradicate HIV infections.

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Stephen De Rosa, MD

Research Professor of Laboratory Medicine and Pathology, University of Washington
External Joint Associate Professor, Vaccine and Infectious Disease Division, Fred Hutch

Dr. De Rosa is a Research Professor at UW and an External Joint Associate Professor at VIDD/Fred Hutch. He has been the Director of the Flow Cytometry Laboratory within the HIV Vaccine Trials Network (HVTN) Laboratory Program for over ten years. For the past two years, he has been devoting effort to evaluating SARS-CoV-2-specific T cell responses to vaccination and infection through the COVID-19 Prevention Network (CoVPN). Thus, he has been providing expertise in multiparameter flow cytometry assays to optimize the development, performance and analysis of flow cytometric assays that enumerate and characterize cellular responses in infectious disease pathogenesis and vaccine studies. He has been trained in the Herzenberg laboratory at Stanford University and at the Vaccine Research Center at the NIH before he came to Seattle. He has trained and directly mentored numerous pre- and post-doctoral researchers in flow cytometry and he has served as a resource for our faculty and trainees that utilize flow cytometry in their research.

Cohen KW, **De Rosa SC**, Fulp WJ, deCamp AC, Fiore-Gartland A, Mahoney CR, Furth S, Donahue J, Whaley RE, Ballweber-Fleming L, Seese A, Schwedhelm K, Geraghty D, Finak G, Menis S, Leggat DJ, Rahaman F, Lombardo A, Borate BR, Philiponis V, Maenza J, Diemert D, Kolokythas O, Khati N, Bethony J, Hyrien O, Laufer DS, Koup RA, McDermott AB, Schief WR, McElrath MJ. A first-in-human germline-targeting HIV nanoparticle vaccine induced broad and publicly targeted helper T cell responses. Sci Transl Med. 2023 May 24;15(697):eadf3309. doi: 10.1126/scitranslmed.adf3309. Epub 2023 May 24. PMID: 37224227.

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Janet Englund, MD

Professor of Pediatric Infectious Diseases, University of Washington
Director, Pediatric Transplant ID, Seattle Children's Hospital
Affiliate Investigator, Vaccine and Infectious Disease and Clinical Research Divisions, Fred Hutch

Dr. Englund is a Professor of Pediatric Infectious Diseases. Her research interest is the impact of respiratory viruses, with particular emphasis on viral dynamics in children and adults with underlying immunosuppressive conditions. She has a strong training record as shown by five post-doctoral fellows who have received K-23 or similar awards. She has worked collaboratively in clinical trials sponsored by NIH/NIAID, CDC, and industry to assess new and old vaccines and improve viral diagnosis in infants, immunocompromised hosts of all ages, Native Americans, children in developing countries, and pregnant women. In the immunocompromised population, she has conducted productive studies of the epidemiology, prevention and treatment of respiratory viral disease due to RSV, influenza virus, rhinovirus (RhV), and human metapneumovirus, as well as respiratory viral diagnosis and long-term outcomes in immunocompromised patients of all ages. Currently, she is working with trainees to establish the importance of viral load in respiratory tract symptoms in children, and collaborating to study new vaccines and antiviral therapies against multiple respiratory viruses including SARS-CoV-2.

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Cynthia Fisher, MD, MPH

Associate Professor of Allergy and Infectious Diseases and Medicine, University of Washington
Adjunct Associate Professor of Microbiology, University of Washington
Affiliate Investigator, Vaccine and Infectious Disease Division, Fred Hutch

Dr. Fisher is an Associate Professor of Infectious Diseases and Adjunct Associate Professor of Microbiology at UW, and an Affiliate Investigator at the Fred Hutch. Her research focuses primarily on the pathophysiology, diagnostics, and treatment of infections targeting immunocompromised hosts. Her specific interests include the role of respiratory virus infections in lung graft failure following lung transplantation, and the prevention, risk factors, and treatment of cytomegalovirus and invasive fungal infections in solid organ and stem cell transplant recipients. In addition, she is currently the PI of a multi- center NIH-funded study looking at the efficacy of an investigational CMV vaccine and a site investigator examining the immunologic response to COVID vaccination in immunocompromised hosts.

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Emily Ford, MD

Assistant Professor, Department of Medicine, Division of Allergy & Infectious Diseases, University of Washington
Affiliate Investigator, Vaccine and Infectious Disease Division, Fred Hutch

Dr. Emily Ford is a physician-researcher, Assistant Professor at the University of Washington, and Associate with the Vaccine and Infectious Disease Division at the Fred Hutch. Her research interests center around the lymphocyte response to HSV, tissue-based immunity, and invasive fungal disease, particularly in the context of the immunocompromised host. She has recently been involved in a number of clinical trials characterizing the immune response to SARS-CoV-2 vaccination and treatment in immunocompromised patients. Additionally, Dr. Ford is interested in characterizing the immune response and evolutionary aspects of patients experiencing HIV, cancer, and/or HSV-2 infection.

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David Fredricks, MD

Professor, Vaccine and Infectious Disease and Clinical Research Divisions, Fred Hutchinson Cancer Research Center
Professor of Allergy and Infectious Diseases and Medicine, University of Washington
Adjunct Professor of Microbiology, University of Washington

Dr. Fredricks is an infectious disease physician, microbiologist, and molecular biologist with more than 27 years of research experience. He has led a research team at the Fred Hutchinson Cancer Center and the University of Washington for the last 20 years that has focused on the study of human microbial communities using both cultivation-independent molecular methods (such as PCR and FISH), and in vitro cultivation approaches. The lab's goal is to advance our understanding of how the indigenous microbiota impacts human health, and to use this knowledge to develop new diagnostic and therapeutic tools. The Fredricks lab has also used

novel cultivation approaches for laboratory propagation of fastidious human-associated bacteria. They have now extended these tools to study the microbiota in patients undergoing hematopoietic cell transplantation. They have also developed molecular diagnostic tests for the detection and identification of fungal pathogens in the immunocompromised host, and Dr. Fredricks has participated in multicenter studies evaluating diagnostics and treatments for fungal infections. Dr. Fredricks has mentored over 70 undergraduate students, graduate students, postdoctoral fellows, and junior faculty.

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Ted Gooley, PhD

Professor, Clinical Research and Public Health Sciences Divisions, Fred Hutch
Director, Clinical Biostatistics Program, Fred Hutch
Director, Biostatistics Shared Resource, Fred Hutch

Dr. Gooley is a Professor at Fred Hutch, where he has been a biostatistician in the Clinical Research Division for the past 24 years. Dr. Gooley's activities within the CRD include the design and analysis of experiments and clinical trials in HCT as well as the analysis of retrospective data in the field of HCT. He is a highly productive investigator with over 270 publications in peer-reviewed journals, many of these with fellows within VIDD and the CRD through various training grants. Access to competent statistical support is essential for both clinical and laboratory investigators and Dr. Gooley will be available to provide this support. In addition, he teaches a course to our fellows on the fundamentals of biostatistics and clinical trials.

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Alex Greninger, MD, PhD

Assistant Professor of Laboratory Medicine & Pathology, University of Washington
Assistant Director, Clinical Virology and Retrovirology Laboratories, University of Washington

Dr. Greninger is an Assistant Professor of Laboratory Medicine & Pathology, and Assistant Director of the clinical virology laboratories with broad training in clinical pathology, virology, epidemiology, and immunology. He has experience in metagenomics for clinical diagnostics, genomics and proteomics of viral infections, and bacterial genomics, with a slant in his basic science laboratory toward mechanisms of replication of picornaviruses, paramyxoviruses, and herpesviruses. Dr. Greninger is also interested in enhancing the clinical laboratory's ability to help patients, and he directs central laboratories for the AIDS Clinical Trial Group and HIV Vaccine Trial Network. The clinical laboratory is a source of abundant data, providing a wealth of opportunity for research.

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Thomas Hawn, MD, PhD

Professor of Allergy and Infectious Diseases and Medicine, University of Washington
Adjunct Professor, Department of Global Health and Laboratory Medicine and Pathology, University of Washington

Dr. Hawn is a Professor of Medicine at UW. He studies the innate immune response to intracellular pathogens. He uses a combination of molecular, cellular, and human genetic techniques to examine the genetic basis and mechanisms of human susceptibility to infectious diseases. His research includes gene function studies that are utilized in conjunction with human genetic analyses of single nucleotide DNA polymorphisms in innate immune response genes in subjects with different infections. Since establishing his laboratory in 2005, he has been the primary mentor for 14 post-doctoral fellows and a co-mentor for 4 post-doctoral fellows and 6 pre-doctoral students. He has mentored 10 previous fellows who obtained career development awards including 8 who transitioned to junior faculty positions.

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Geoffrey R. Hill, MD, FRACP, FRCPA

José Carreras/E. Donnall Thomas Endowed Chair for Cancer Research
Senior Vice President and Director , Translational Science and Therapeutics, , Fred Hutch
Professor, Translational Science and Therapeutics Division, Fred Hutch
Scientific Director of the Immunotherapy Integrated Research Center, Fred Hutch
Director of Hematopoietic Stem Cell Transplantation, Fred Hutch
Professor of Medicine and Division of Hematology and Medical Oncology, University of Washington

Dr. Hill's laboratory focuses on transplant immunology and continues to span basic discovery research and translational clinical practice, utilizing cutting-edge immunological techniques including advanced cell and whole organism imaging, flow cytometry, proteomics and RNASeq. His studies have focused on addressing the major limitations of bone marrow transplantation, namely graft-versus-host disease (GVHD), opportunistic infection and relapse. Studies in the GVHD setting have focused on understanding the mechanisms of alloantigen presentation, T cell differentiation (both effector and regulatory) and cytokine biology where we have led the field with a number of pivotal late phase translational clinical studies underway. His work in opportunistic infections has focused on CMV and understanding the immunological requirements for virus control, developing the first models of CMV reactivation after allogeneic BMT that allow preclinical testing of immunomodulation strategies to improve pathogen-specific immunity.

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Joshua A Hill, MD

Associate Professor, Vaccine and Infectious Disease and Clinical Research Divisions, Fred Hutch
Associate Professor of Allergy and Infectious Diseases and Medicine, University of Washington

Dr. Joshua A. Hill is an Assistant Professor at the Fred Hutchinson Cancer Center (FHCC) and the University of Washington (UW). His research program is focused on clinical and translational studies to improve preventive and treatment strategies for infections in patients receiving hematopoietic cell transplantations (HCT) and CAR-T cell therapies. Dr. Hill trained in Transplant Infectious Diseases at FHRC and epidemiology/biostatics at the Harvard School of Public Health. He serves as an attending physician on the Immunocompromised Host Infectious Diseases Service at the FHCC, and UW Medical Center-Montlake.

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Ollivier Hyrien, PhD

Professor, Vaccine and Infectious Disease and Public Health Science Divisions, Fred Hutch

Dr. Hyrien is a Full Professor at Fred Hutch. He is trained in statistics, and his methodological research is focused on developing statistical and machine learning approaches as well as mathematical models to characterize immune responses to vaccination or infection using high- throughput and next generation sequencing data. His collaborative research includes designing pre- clinical and clinical trials to study vaccine and monoclonal antibodies for the prevention of infection from exposure to HIV and other pathogens. A major focus of his current work in on studying evolution of the B cell repertoire and germline-targeting vaccines.

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Keith Jerome, MD, PhD

Professor of Laboratory Medicine & Pathology, University of Washington
Professor, Vaccine and Infectious Disease ***Division, Fred Hutch***
Head, Virology Division, University of Washington

Dr. Jerome is a Professor of Laboratory Medicine and Pathology and Head of the Virology Division at the UW as well as a Professor at Fred Hutch. His academic and clinical work focuses on the diagnosis of viral infections, and the development of gene therapy approaches to the cure of chronic viral infections. As head of the Virology Division, he is an essential collaborator and mentor for many projects and trainees. He has successfully trained undergraduate students, graduate students, as well as postdoctoral scientist and fellows.

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Christine Johnston, MD, MPH

Associate Professor of Allergy and Infectious Diseases and Medicine, University of Washington
Associate Program Director, Infectious Diseases Fellowship Training Program, University of Washington
Adjunct Associate Professor, Department of Laboratory Medicine and Pathology
Affiliate Investigator, Vaccine and Infectious Disease Division, Fred Hutch

Dr. Johnston is an infectious disease physician with over 15 years of experience conducting clinical research to study chronic viral infections, with a focus on herpesvirus. Her research focuses on the natural history and pathobiology of herpes simplex virus (HSV) infections, with the ultimate goal of creating new strategies to prevent and treat HSV. Her studies enroll participants into intensive specimen collection protocols to understand immunologic and virologic factors that are associated with variable clinical phenotypes of HSV infection. She works closely with a multidisciplinary group of laboratory and biostatistics colleagues. In addition, she served as PI for SARS-CoV-2 treatment and vaccine trials. As Associate Program Director of the ID Fellowship, she has experience mentoring fellows with a variety of interests and career paths.

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David Koelle, MD

Professor of Allergy and Infectious Diseases and Medicine, University of Washington Adjunct Professor of Global Health, University of Washington
Joint Professor of Laboratory Medicine and Pathology, University of Washington
Affiliate Investigator, Vaccine and Infectious Disease Division, Fred Hutch
Affiliate, Benaroya Research Institute

Dr. Koelle has been mentoring pre-doctoral and post-doctoral MD and PHD scientists since joining the faculty in 1997. His lab is interested in the T cell immune responses to infections and vaccines, and particularly in herpes and tumor viruses and sexually transmitted infections. Pathogens include SARS-CoV-2, HSV, VZV, human herpesvirus 6, vaccinia, *Treponema pallidum*, *Mycobacterium tuberculosis,* and Merkel cell polyoma virus (MCPyV). Candidate HSV-1 and HSV-2 vaccine candidates have been identified, studied in mice and entered clinical trials. We are trying to harness T cells to treat Merkel cell carcinoma. We use pathogen genomic libraries and genome-spanning ORF sets to interrogate CD8 and CD4 T-cell responses to a very high level of definition. A specific focus is tissue resident memory T cells (TRM) at sites of infection, such as skin, the female genital tract, the cornea, trigeminal ganglia, and in tumors. A newer initiative is study of T-cell

repertoires using single cell and bulk sequencing of T-cell receptor (TCR) hypervariable regions and expression of functional recombinant T-cell receptors. SARS-CoV-2 work includes detailed TCR sequencing of virus-specific T cells, epitope discovery, and measurement of T cell interactions with infected epithelial cells.

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Wendy Leisenring, ScD

Professor, Clinical Research and Public Health Divisions, Fred Hutch

Dr. Leisenring is a Professor in the Clinical Biostatistics group at Fred Hutch, where she has collaborated with clinical scientists nearly three decades. Her work encompasses a variety of study types, including prospective and retrospective cohort studies and clinical trials, for which she plays a key role in design and analyses. Within the HCT domain, her projects span a wide range of topics, including infectious disease diagnosis, epidemiology, treatment, prevention and detection of long-term outcomes after HCT. Dr. Leisenring also leads the statistical center for the Childhood Cancer Survivor Study, which includes more than 20,000 survivors being studied for late effects of their cancer treatment. Dr. Leisenring is an essential resource to research fellows at the Fred Hutch while they work on their research projects; she provides mentoring on the collaborative process of working together with a statistician, formulating hypotheses, designing studies, gathering relevant data and carrying out analyses to answer compelling questions.

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Catherine Liu, MD

Professor, Vaccine and Infectious Disease and Clinical Research Divisions, Fred Hutch
Professor of Allergy and Infectious Diseases and Medicine, University of Washington
Director, Antimicrobial Stewardship and Outpatient Antimicrobial Therapy Programs, Fred Hutch
Associate Director of Infection Control, Fred Hutch

Dr. Liu serves as Director of the Antimicrobial Stewardship and Outpatient Parenteral Antimicrobial Therapy Programs and the Associate Director of Infection Prevention at the Fred Hutch. She joined the faculty at Fred Hutch and UW in 2017 from the University of California, San Francisco where she served on faculty for 9 years. Her goal is to optimize antibiotic use to prevent the emergence of drug-resistant organisms and achieve the best clinical outcomes for patients. Her research focuses on antimicrobial resistance, antimicrobial and diagnostic stewardship among cancer and hematopoietic cell transplant patients. Projects aim to identify opportunities and strategies to prevent and optimize management of infections among cancer patients. She has an interest in clinical guideline development to improve patient care and standard practice and has participated in guideline development on a local and national level. She has successfully mentored numerous students, residents, and fellows on a variety of projects.

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Denise McCulloch, MD, MPH

Assistant Professor, Vaccine and Infectious Disease and Clinical Research Divisions, Fred Hutch
Assistant Professor, Division of Allergy and Infectious Diseases, University of Washington
Assistant Director of Infection Prevention, Assistant Medical Director of the Infectious Diseases Outpatient Clinic, Fred Hutch

Dr. Denise McCulloch is a physician and epidemiologist who specializes in infectious diseases and is focused on the study of respiratory viruses in immunocompromised populations. Her interest in viral diagnostics and immune responses to infection took her in 2019 to the University of Washington laboratory of Dr. Helen Chu, who was carrying out surveillance of influenza and other respiratory diseases in vulnerable populations. There she also worked on the Seattle Flu Study, which detected and responded to the first known cases of community transmission of COVID-19 in the United States. Dr. McCulloch's experience with clinical trials of home-based testing and treatment of SARS-CoV-2 informs her current epidemiological studies of viruses that cause respiratory infections.

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Evan Newell, PhD

Associate Professor, Vaccine and Infectious Disease and Public Health Sciences Divisions, Fred Hutch
Adjunct Associated Professor, Department of Laboratory Medicine and Pathology, University of Washington

Dr. Newell is an Associate Professor at Fred Hutch and Adjunct Associate Professor at University of Washington. His research focuses on understanding the human T cell mediated immune response to infectious disease and cancer. His lab has developed novel systems for identifying and thoroughly characterizing antigen-specific T cells derived from human blood and tissue samples. This included the development of combinatorial peptide- MHC tetramer staining, which allows for multiplexed assessment of up to hundreds of T cell antigen specificities in a single sample, and the first application of mass cytometry (CyTOF) to deeply probe the phenotypic and functional characteristics of antigen specific T cells. His lab applies mass cytometry, flow cytometry, single-cell sequencing and TCR sequencing for human and mouse immune profiling applications. Throughout this work, the lab also has a keen interest in developing better ways to visualize and quantitatively compare high dimensional datasets.

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Steven Pergam, MD, MPH

Professor, Vaccine and Infectious Disease and Clinical Research Divisions, Fred Hutch
Professor of Allergy and Infectious Diseases and Medicine, University of Washington
Director, Infection Prevention, Fred Hutch
Adjunct Associate Professor of Epidemiology, University of Washington

Dr. Pergam is a Professor in the Vaccine and Infectious Disease and Clinical Research Divisions of Fred Hutch and a Professor at the UW. He also serves as Director of Infection Prevention at the FHCC. His current research interests involve infection prevention in immunosuppressed hosts. Dr. Pergam's research group focuses on the epidemiology of major pathogens, antimicrobial stewardship, and on the development of novel prevention strategies for community and healthcare-associated infections in cancer and hematopoietic cell transplant patients. He is specifically interested in the interplay between the

immune response, the microbiome, bacterial and viral infections in the respiratory and gastrointestinal systems, and their association with inflammatory complications (e.g. GVHD, mucositis). Dr. Pergam's research group has developed novel data and expertise in patient quality and safety in high-risk immunosuppressed patients. Dr. Pergam has a long track record of mentorship and expertise in epidemiology, clinical trial design, and statistical analyses. He is part of the FDA committee that votes on COVID vaccines and is interested in vaccines in immunosuppressed patients.

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Hans Peter-Kiem, MD, PhD

Deputy Director, Translational Science and Therapeutics Division, Fred Hutch
Professor, Clinical Research and Vaccine and Infectious Disease Divisions, Fred Hutch
Stephanus Family Endowed Chair for Cell and Gene Therapy, Fred Hutch
Associate Head, Hematological Malignancies Program, Fred Hutch/University of Washington/Seattle Children's Cancer Consortium
Professor, Adjunct Professor of Pathology, School of Medicine, University of Washington

Dr. Hans-Peter Kiem is a world-renowned pioneer in stem-cell and gene therapy and in the development of new gene-editing technologies. His focus has been the development of improved treatment and curative approaches for patients with genetic and infectious diseases or cancer. For gene editing, his lab works on the design and selection of enzymes, known as nucleases, which include CRISPR/Cas. These enzymes function as molecular scissors that are capable of accurately disabling defective genes. By combining gene therapy's ability to repair problem-causing genes and stem cells' regenerative capabilities, he hopes to achieve cures of diseases as diverse as HIV, leukemia and brain cancer. With preclinical models of HIV, Dr. Kiem and his colleagues have demonstrated that they can modify a key viral entry gene and prevent it from working in transplanted blood stem cells. He also hopes to apply these technologies to cure genetic blood disorders such as Fanconi anemia and sickle cell disease. He is also pioneering in vivo gene therapy approaches to make gene therapy and gene editing more broadly available and accessible to patients and those living with HIV, especially in resource-limited settings.

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Warren Phipps, MD, MPH

Associate Professor, Vaccine and Infectious Disease Division, Fred Hutch
Associate Professor, Allergy and Infectious Diseases and Medicine, University of Washington
Medical Director, Uganda Cancer Institute-Fred Hutch Collaboration

Over the last 12 years, Dr. Phipps has served as the Uganda Cancer Institute (UCI) – Fred Hutchinson Cancer Center (Fred Hutch) Collaboration and oversees the program's research activities on infection-related cancers in Kampala, Uganda. His research focuses on HIV-associated malignancies, with a particular emphasis on human herpesvirus-8 (HHV-8) virology and the pathogenesis of Kaposi sarcoma (KS), among the most common HIV-associated malignancy worldwide. Dr. Phipps also studies the impact of HIV and antiretroviral therapy on cancer incidence and outcomes in Uganda, and provides clinical care to cancer patients with infection complications at the UCI.

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Martin Prlic, PhD

Professor, Vaccine and Infectious Disease Division, Fred Hutch
Affiliate Associate Professor, Department of Global Health and Department of Immunology, University of Washington

Dr. Prlic primarily studies T cell and innate-like T cell responses in mucosal tissues, with a particular interest in understanding how these cells function in different inflammatory environments, including infections and cancer. By defining the functional plasticity and functional potential of T cells in health and a range of different disease states, he aims to understand how to manipulate these cells to our advantage. Dr. Prlic's goal is to understand the molecular basis of cell activation and differentiation to learn how to manipulate the cells for therapeutic purposes and ultimately improve human health.

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Joshua Schiffer, MD, MSc

Professor, Vaccine and Infectious Disease and Clinical Research Divisions, Fred Hutch
Professor of Allergy and Infectious Diseases and Medicine, University of Washington

Dr. Schiffer is a Professor in VIDD at the Fred Hutch and Professor at UW. His scientific program bridges laboratory-based studies with mechanistic mathematical models to capture dynamic interactions between viral pathogens and the human immune system. He is R01 supported and has an outstanding publication and mentoring record. A major focus has been on the complex kinetics of HSV-2 reactivations in the genital tract. Current research areas include modelling: SARS- CoV-2 viral dynamics and transmission; simulation of antiviral therapy clinical trials for dose optimization; strategies to achieve cure of HIV; approaches to tissue-resident T-cells within three- dimensional microenvironments; and shifts in the human microbiome and viral dynamics in childhood human herpes virus infections.

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Alpana Waghmare, MD

Associate Professor of Pediatrics, University of Washington
Assistant Professor, Vaccine and Infectious Disease Division, Fred Hutch

Dr. Waghmare's research is in the field of translational infectious diseases, with a particular focus on respiratory viral infections. Her interest in viral infections in immunocompromised hosts stems from her experiences as a clinician, where she witnessed the impact of respiratory viral infections in vulnerable populations. Dr. Waghmare translated her interest in respiratory viruses into clinical research projects including the investigation of risk factors for RSV-associated mortality and the use of a novel antiviral for parainfluenza virus infection. While these pathogens, she began to appreciate the impact of an often-overlooked respiratory pathogen, human rhinovirus. Dr. Waghmare's current research interests involve evaluating biomarkers for disease severity in HCT recipients with rhinovirus infection and she been awarded a K23 award from the National Institute of Allergy and Infectious Diseases to pursue this work.

Waghmare A, Hijano DR. SARS-CoV-2 Infection and COVID-19 in Children. Clin Chest Med. 2023 Jun;44(2):359-371. doi: 10.1016/j.ccm.2022.11.014. Epub 2022 Nov 22. PMID: 37085225; PMCID: PMC9678836.

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Anna Wald, MD, MPH

Professor of Medicine, Epidemiology, and Laboratory Medicine & Pathology, University of Washington
Professor, Vaccine and Infectious Disease Division, Fred Hutch
Head, Allergy and Infectious Diseases Division, University of Washington
Director, Virology Research Clinic, University of Washington

Dr. Wald is head of the UW Division of Allergy and Infectious Diseases and the Director of the UW Virology Research Clinic. Her clinical research has centered on HSV-2 infections, but also includes other viral pathogens as well as vaccine studies. Her current NIH support includes VTEU funding from NIAID as

part of the Infectious Diseases Clinical Research Consortium and Sexually Transmitted Infections Collaborative Research Center that focuses on developing a syphilis vaccine. She has additional funding from NCI to evaluate HPV vaccine for high grade neoplasia of the genital and anal tract in women and men. In the past, she has received a K24 award from NIAID for mentoring early-stage investigators. In the last 2 years, her research has pivoted to clinical trials of COVID-19 vaccines as well as studies to evaluate the virological course and the immune response to natural infection and vaccines. She has been a colleague and a collaborator of Dr. Boeckh for more than 2 decades, and they have successfully co-mentored many trainees.

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Michael Wu, PhD

Professor, Public Health Sciences Division, Fred Hutch
Affiliate Associate Professor of Biostatistics, University of Washington

Dr. Wu is a Professor at Fred Hutch. His group develops and applies cutting edges statistical and computational approaches for complex omics data, including microbiome, metagenomic, genomics and other lab assay based data. Several approaches now represent the standard within many analytic pipelines and have been used to identify thousands of novel findings. Dr. Wu also has a deep commitment to mentoring and training of students, fellows, and post docs, including service on F and K grants.

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Danielle Zerr, MD, MPH

Professor of Pediatrics, University of Washington
Adjunct Professor of Epidemiology, University of Washington
Affiliate Investigator, Vaccine and Infectious Disease Division, Fred Hutch

Dr. Zerr is a Professor of Pediatric Infectious Diseases and Division Chief of Pediatric Infectious Disease at Seattle Children's Hospital. She is an Infectious Disease scientist with training in epidemiology, a successful track record in mentoring, and experience in leading clinical research focused on human herpesvirus 6 (HHV-6) infection and healthcare-associated infections. She has been the PI or co-investigator of several NIH-, university-, and industry-sponsored grants, including an NIH career

development award and R01s focused on the epidemiology of HHV-6, and healthcare associated infections. She is a productive investigator that has conducted multiple retrospective as well as several large prospective clinical studies, a portion of which have involved immunocompromised populations.

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Jia Zhu, PhD

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Dr. Zhu has appointments at both Fred Hutch and the University of Washington, where she leads a team that studies the tissue-based immune response to herpes simplex virus (HSV) infection in human skin. She has spent most of her career focused on understanding intricate interactions between humans and HSV, which can be successfully suppressed in a healthy host but can cause more severe complications in immunocompromised individuals. Early on she developed novel laboratory tools to detect how immune cells behave in genital tissues during the active and latent phases of herpes infection. These pivotal studies showed that CD8+ T cells remain at previous sites of HSV lesions and accumulate near sensory nerve endings, where reactivating HSV is released. Currently, the lab is using high dimensional multiplex immunofluorescence staining in combination with transcriptional analysis to characterize the spatial-temporal relationship between T cells and the surrounding network of immune and non-immune cells in the tissue. She has developed many research partnerships and her group is highly collaborative.

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