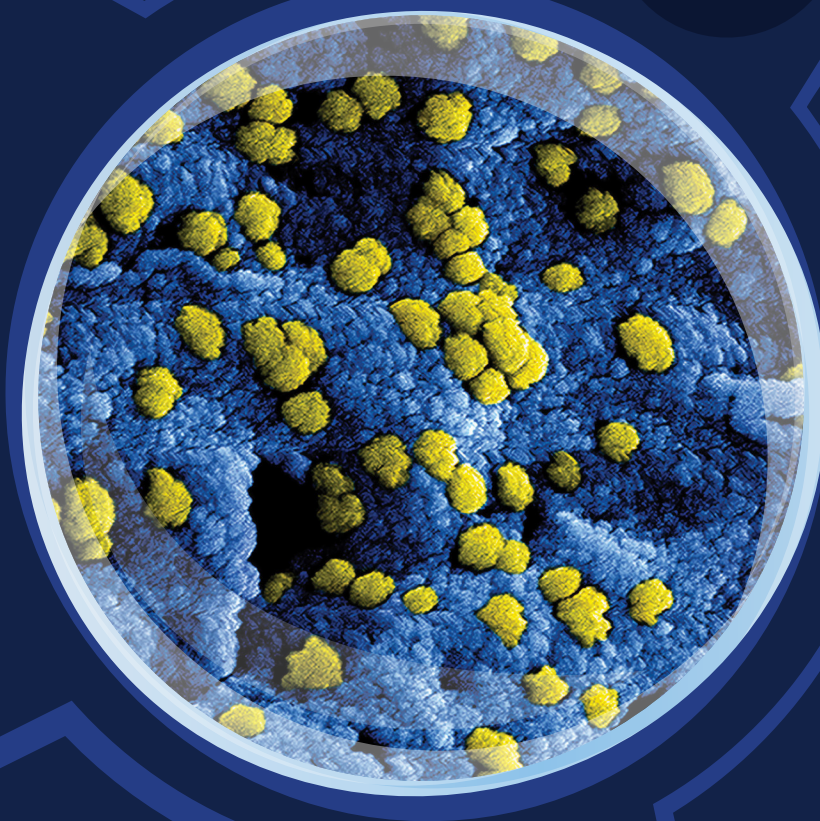


PIONEERING DISCOVERIES IN
**Human Microbiome
Research**



Benioff Center for
Microbiome Medicine

UCSF

University of California
San Francisco



Leading the way in microbiome science: UCSF Benioff Center members at the 2024 inaugural retreat at Asilomar Conference Grounds

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Welcome

As the Director of the Benioff Center for Microbiome Medicine (BCMM), I am thrilled to share our progress since our launch five years ago, and our vision for the future. Funded by an incredibly generous gift from Marc and Lynne Benioff, our center is dedicated to pioneering research that explores the profound impact of the microbiome on human health and disease. Through our cutting-edge research efforts spanning all four schools of Dentistry, Medicine, Nursing and Pharmacy at the University of California San Francisco, we unravel the complexities of microbial communities and their interactions with our bodies, with the ultimate goal of translating these insights into novel prognostics, diagnostics and transformative personalized therapies.

Our exceptional community is committed to leveraging the advanced and integrative research infrastructure we have built and to fostering interdisciplinary collaborative efforts to accelerate discovery in the field. We are excited for the potential of our research to not only deepen our understanding of the human microbiome but also to significantly enhance patient care and improve clinical outcomes.

I am indebted to our exceptional executive committee for their support and engagement as we continue this important journey. Together, we are advancing the frontiers of microbiome medicine and making strides toward a healthier future.

Warm regards,

Susan Lynch, PhD,
Director, Benioff Center for Microbiome Medicine

The Benioff Center for Microbiome Medicine Executive Committee

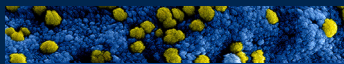


Pictured from left to right: Sergio Baranzini, PhD; Julie Saba, MD, PhD; Tiffany Scharschmidt, MD and Peter Turnbaugh, PhD

BENIOFF CENTER FOR MICROBIOME MEDICINE Roadmap

2019

- Introductory meeting with campus-wide stakeholders
- First staff hired
- Launch of Microbiome



Ignite Talks

Benioff Center for
Microbiome Medicine



2020

- Establishment of
- Launch of led by technology hub directors
- Launch of – first 14 projects funded
- Initiation of the study in collaboration with UCSF Preterm Birth Initiative
- Developed collaborative efforts with our partner program in Immunology, ImmunoX
- First BCMM graduate trainee fellowships awarded
- Launch of



2021

program established. Inaugural summer internship for high school students.

Co-hire of two new faculty: Renuka Nayak, MD, PhD and Alexis Combes, PhD



Program for Biomedical Breakthrough Research award to purchase GC-MS and MALDI

Held first annual

BCMM hosts 6-part

Microbiome Video Competition for middle and high school students



2022

Co-hire of two new faculty:
Kelsey Collins, PhD and
Chris Hernandez, PhD



Generous gift from
Dr. Larry Berkelhammer's
supports launch of the Oral
Microbiome Research
Program in partnership with
UCSF School of Dentistry

Launch of trainee-focused
programming including
and

BCMM faculty offer a six-
lecture
microbiome course to public

Renovations begin on BCMM
research space and on an
expanded

Collaborative research
efforts with the Benioff
Initiative for Prostate Cancer
Research begin

Launch collaborative
research efforts with Bakar
Computational Health
Sciences Institute

15 studies aids

2023

– A collaboration
between UC Berkeley, UC
Davis and BCMM to develop
CRIPSR-based microbiome
therapeutics

Launch of



Research and Mentorship
Program (RaMP) scholars
program established



Darren Dumlao, PhD hired as
the Assistant Director of
the

Community established

Awarded Core Assistance
Funds to purchase additional
instruments

Additional gift from
Dr. Berkelhammer aids
studies of the gut microbiome
in Parkinson's disease

BCMM is a founding
member of the Parnassus
Institutes

Program for Biomedical
Breakthrough Research
award to purchase a
Microbial Single Cell Sorter

2024

The newly renovated
Gnotobiotic Mouse
Research Facility opens

New faculty member,
Soumaya Zlitni, PhD hired



Inaugural
at Asilomar

Rahim Khan, PhD becomes
Manager

Lu Yang, PhD to lead BCMM
hub

National Institutes of Health
award provides **\$8M for
renovation of QMAC space**

HSE11 space renovations
completed for BCMM
faculty and staff



RESEARCH

Leader in Microbiome-based Medicine

The BCMM is leading two collaborative initiatives around our primary areas of focus: early life microbiome development and microbiome interactions with disease therapeutics.



PREMO: Premature Microbiome and Outcomes

Longitudinal sampling of stool, nasal, skin, and blood of infants born pre- or full-term to link microbiome-immune development to clinical outcomes and develop personalized nutritional/microbial interventions to improve outcomes related to preterm birth.

- 100 pre-term babies and their mothers
- Large and longitudinal sample repository from a highly characterized patient population



Therapeutics

Genotypical and biochemical characterization of clinically relevant human-derived microbial species and strains to screen for novel microbial-derived therapies.

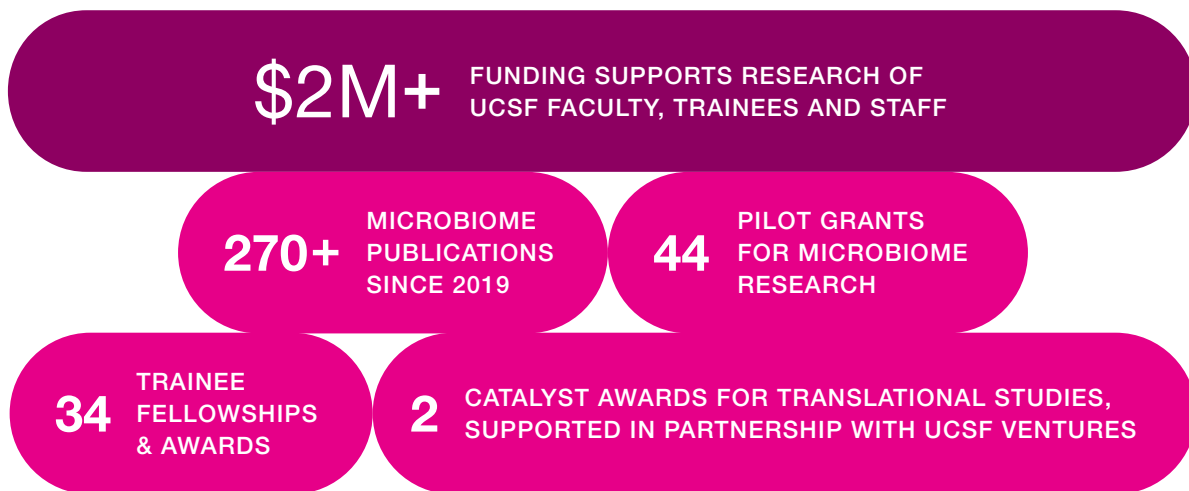
- Bank of over 2,000 human derived species
- New translationally relevant gnotobiotic mouse models
- Electronic health records to systematically link clinical metadata to microbiome profiles
- Centralized data integration through UCSF's Scalable Precision medicine-Oriented Knowledge Engine (SPOKE)

RESEARCH

Health Impacts of the Microbiome

Since its start, the BCMM has supported microbiome research projects across various areas and disciplines. Our commitment to fostering innovation and collaboration has enabled faculty and trainees to explore new frontiers in microbiome medicine and accelerated the pace of scientific advancement.

Funded Research Spans Multiple Fields and Disciplines:



RESEARCH

Investing in Groundbreaking Research

Commensal Microbes Boost Immune Cell Development in Newborn Skin

Miqdad Dhariwala, a prior postdoc in Tiffany Scharschmidt's lab, was one of the first recipients of the BCMM Trainee Pilot Award in 2020. Miqdad utilized the funding to perform multi-OMICs assays on sorted myeloid cell populations from the skin of germ-free and specific pathogen-free mice. This funding, supplemented by an NIH

K99 career transition award, provided the first evidence that commensal microbes facilitate the accumulation of a specific population of monocytes in neonatal skin that promotes long-term immune homeostasis. The data generated from these studies have provided the groundwork for Dr. Dhariwala's ongoing research efforts in his current role as an Assistant Professor at Ohio State University.



“ *The award helped me generate data and new hypotheses to successfully secure NIH K99/R00 funds.*

MIQDAD DHARIWALA, PHD

Effect of Dietary Intervention Immunity and Microbes in Ulcerative Colitis Patients

Michael Kattah, an Assistant Professor in the Division of Gastroenterology at UCSF, received research support through a BCMM Faculty Project Award in 2022-2023. His work focuses on identifying microbial, immune, and epithelial changes in ulcerative colitis (UC) patients following initiation of an anti-inflammatory diet. The award enabled Dr. Kattah to enhance

methodologies for spatial transcriptomics of UC patient biopsies at single-cell resolution and antibody profiling in preserved samples from the same patients. Ongoing efforts include integrative microbial and human sample analyses using a combination of amplicon sequencing, dual RNA sequencing, spatial transcriptomics, and collaborative data analysis with the Microbial Genomics Core.



“ *The funding helped us fully optimize our spatial multi-omics pipeline for ulcerative colitis, and now we are working on combined host and microbial analysis in intestinal biopsies.*

MICHAEL KATTAH, MD PHD



Empowering our Next Generation of Microbiome Leaders

BCMM offers advanced professional training and specialized workshops in microbiome research.

Since our launch in the fall of 2019, we have been committed to driving forward the field of microbiome research through robust training

and career development programs. Under the leadership of our past and present BCMM trainee ambassadors, we've rolled out a range of initiatives designed to foster both educational and professional advancement. These include our graduate fellowship program, trainee travel awards, and specialized workshops for career development. As we move forward, BCMM continues to invest in driving the field of microbiome research forward through robust training and development efforts.



CURRENT BCMM TRAINEE AMBASSADOR

Margôt Bacino, graduate student in the Oral and Craniofacial Sciences Graduate Program at UCSF

FORMER BCMM TRAINEE AMBASSADORS

Joël Babdor, PhD and Miqdad Dhariwala, PhD

50+

SCIENCE SEMINARS

Annual

SUMMER INTERNSHIPS

Ongoing

WORKSHOPS & TRAININGS

Monthly

IGNITE SEMINARS

Annual

MICROBIOME SYMPOSIUM



Development of Microbiome Research Resources

The Benioff Center for Microbiome Medicine oversees a suite of specialized facilities, including the Gnotobiotic Mouse Research Facility, the Microbial Genomics and Culture Facility and the Quantitative Metabolite Analysis Center (QMAC). These state-of-the-science centers are designed to drive the discovery and application of microbiome-based innovations, transforming disease treatment and enhancing patient care. By democratizing essential resources and expertise, we are committed to advancing our understanding of the microbiome across a wide range of research fields and clinical specialties.



Gnotobiotic Mouse Research Facility

BCMM has made a significant commitment to advancing our research capabilities through the renovation and expansion of the Gnotobiotic Mouse Research Facility. Gnotobiotic technology is essential for breeding and maintaining germ-free animals, providing a unique platform to study the effects of specific microbes or microbial communities on host physiology and health.

Under the expert leadership of Dr. Jessie Turnbaugh, the Gnotobiotic Core at UCSF offers comprehensive support, guiding researchers from the initial stages of their projects to their successful completion. The newly renovated facility, which officially opened in 2024, greatly enhances our experimental throughput and offers extensive in-house training opportunities.



Quantitative Metabolite Analysis Center

At the BCMM, we have strategically invested in advanced mass spectrometry platforms for molecular analyses of biospecimens and to cement our position as a leader in integrated microbiome research.

Our Quantitative Metabolite Analysis Center (QMAC), managed by Dr. Darren Dumlao, now boasts five instruments, including two hybrid triple quadrupole linear ion trap mass spectrometers, optimized for sensitivity and high throughput targeted quantification; two high resolution mass spectrometers for untargeted metabolomics; and a matrix-assisted laser desorption ionization–time of flight (MALDI) spectrometer for detailed metabolite profiling. We are also eagerly anticipating the installation of a state-of-the-art gas chromatography mass spectrometer (GC-Orbitrap) in 2025, which will significantly advance our ability to detect and analyze small, non-polar metabolites. Our commitment to multi-disciplinary microbiome research is further exemplified by the upcoming addition of a spatial mass spectrometer, generously funded by the Bakar Aging Research Institute.



Microbial Genomics and Culture Facility

The Microbial Genomics and Culture Facility, managed by Dr. Abdur Rahim Khan, is equipped with cutting-edge sequencing technologies to support comprehensive microbiome research. It includes high-throughput sample preparation, advanced sequencers for next-generation sequencing (NGS), and bioinformatics platforms for data analysis. The facility offers various genomic applications, including 16S rRNA amplicon sequencing, whole-genome sequencing, RNASeq, and shotgun metagenomics. Additionally, it provides expert support for experiment design, data analysis, interpretation, manuscript preparation, and funding applications.

To enhance our capabilities, we have secured funding for a high-throughput microbial single cell isolation platform. This new instrument, installed and validated in 2023, has significantly improved our ability to isolate bacterial and fungal cells from clinical specimens. We are also developing protocols for microbial single cell sequencing, allowing us to achieve unparalleled resolution of microbial populations. These advancements support our functional screening studies and enable us to explore microbial functions and interactions with unprecedented precision.



EDUCATION **Fostering Inclusion in Microbiome Studies**

BCMM is deeply committed to advancing education, training, and outreach.

In collaboration with Mayor London Breed's San Francisco Opportunities for All initiative, we have established an impactful in-person summer internship program for underserved high school and undergraduate students. In partnership with UC Berkeley, San Francisco State University, and Cal State East Bay, we've developed a 10-month embedded training program through the Research and Mentorship Program (RaMP). Funded by a National Science Foundation award, this initiative offers structured mentorship and project funding for post-baccalaureate students from underrepresented communities who are exploring careers in microbiome research. Our summer interns and

RaMP scholars have maintained their passion for microbial sciences while pursuing degrees in biological sciences and medicine, and securing science-related positions in academia and industry, showcasing the transformative experiences and valuable skills gained at BCMM.

In 2024, BCMM provided funding to support the ImmunoExplore summer camp. This program offers underrepresented high school students from the Bay Area the opportunity to interact with UCSF students and faculty, providing valuable exposure to careers in science and medicine focused on the immune system. Moving forward, we will continue to nurture and expand these crucial educational and training components of our mission.



“ *The internship opportunity has broadened my perspective on available career paths.*

JENNY LEE, BS, FORMER SUMMER INTERNSHIP STUDENT AND CURRENT RESEARCH ASSOCIATE, MICROBIAL GENOMICS AND CULTURING FACILITY, BCMM



COMMUNITY **Sparking Microbiome Curiosity Through Outreach**

At BCMM, we are dedicated to promoting scientific curiosity through a variety of outreach activities.

During the COVID-19 pandemic, Dr. Peter Turnbaugh, a valued member of our Executive Committee, launched the “Science is Fun” podcast. This initiative aims to make science both accessible and enjoyable for a broad audience.

Our outreach efforts also include hosting the Microbiome Video Competition for Bay Area students, where a standout 6th grader received top honors in the inaugural 2021 competition.

We actively support STEM education by visiting schools to introduce students to the science career path and developing microbiology projects tailored for junior high school students, nurturing the growth of young scientific minds.

Recognizing the frequent interactions between art and science in our research, BCMM sponsored a campus-wide event, Canvas and Cultures, a Science and Art Soiree at our Mission Bay campus. This event, open to the entire UCSF community, featured an inspiring talk by Dr. David Schneider, PhD, Stanford University, on the intricate connection between science and art. Dr Schneider’s presentation was followed by an exhibition of artwork created by scientists and staff from across our UCSF community.

Strengthening Inter-disciplinary Alliances

Planned expansions at UCSF will strengthen our existing partnerships, and support long-term, innovative research in microbiome medicine.

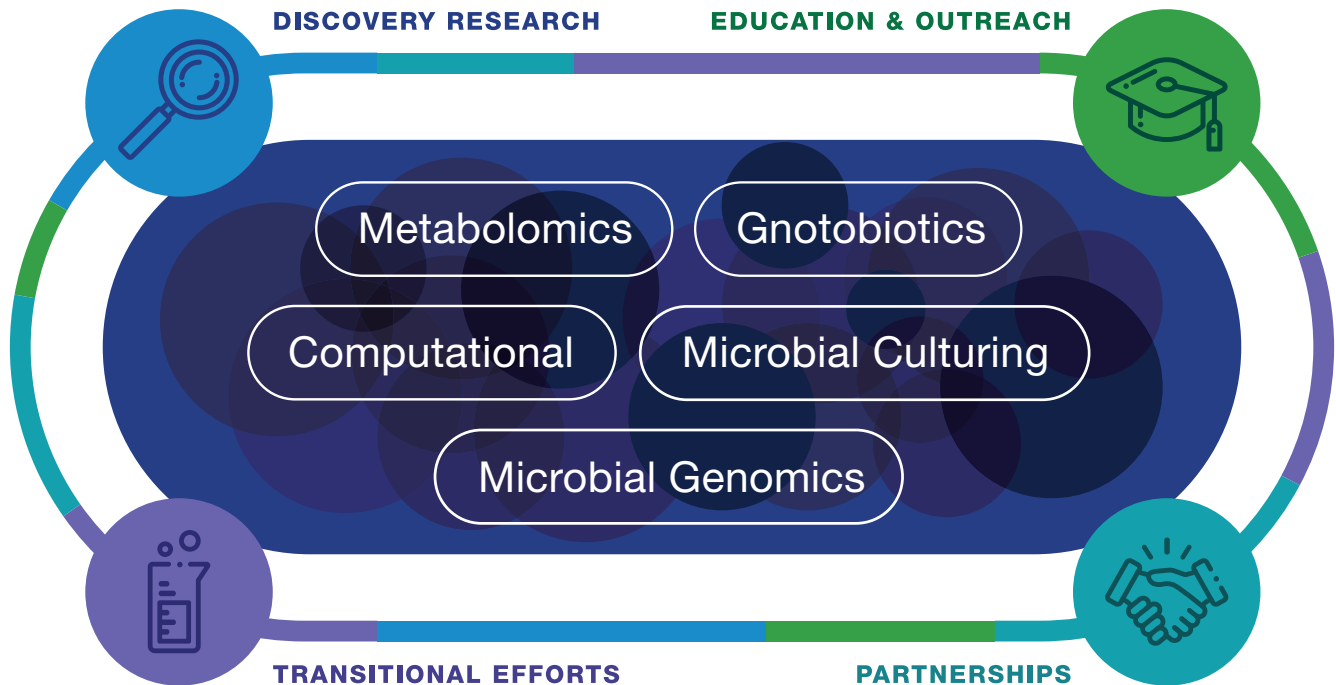
BCMM is set to expand its footprint in the new UCSF Barbara and Gerson Bakar Research and Academic Building (BRAB). A state-of-the-science facility that will drive innovations in scientific research and education, the BRAB will house investigators from a range of programs including BCMM, the Cancer Center, the Diabetes Center, iMICRO, ImmunoX and Cell Biology.

A key component of UCSF's new research environment is to expand the impactful CoLabs, a groundbreaking concept that brings together established core laboratories to offer a new model for research collaboration. BCMM's technology hubs, including Gnotobiotics, Microbial Genomics,



and QMAC, operate as collaborative laboratory (CoLab) incubators and plug-ins and will be more fully integrated into the CoLabs model in this new research environment.

BCMM has also received NIH funding to renovate 3,100 square feet at the Parnassus Heights campus to enhance the Quantitative Metabolite Analysis Center (QMAC). This upgrade will allow us to centralize our growing catalog of mass spectrometry instruments and modernize our facilities to better support the expanding field of metabolomics research.



BCMM Senior Staff

Powering the Center's Mission: Meet the BCMM Senior Staff, driving innovation and transformative research in microbiome medicine.



Pictured left to right: Kristin Dolan, PhD, Assistant Director Operations and Strategy; Slavena Vylkova, PhD, Scientific Communications Manager; Darren Dumlao, PhD, Assistant Director, QMAC; Abdur Rahim Khan, PhD, Manager, Microbial Genomics and Culturing; Jessie Turnbaugh, PhD, Director, Gnotobiotics; Lu Yang, PhD, Computational Specialist

BCMM Research Collaborations



Benioff Center for
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