

BIOGRAPHICAL SKETCH

NAME: Chiu, Charles Yen

eRA COMMONS USER NAME (credential, e.g., agency login): CHIUCHA

POSITION TITLE: Professor of Laboratory Medicine and Medicine, Division of Infectious Diseases; Director, UCSF Clinical Microbiology Laboratory; Chan-Zuckerberg Biohub Investigator

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
University of California at Berkeley, CA, USA	B.S. (Honors)	05/1993	Electrical Engineering and Computer Science
University of California at Los Angeles, CA, USA	M.D., Ph.D.	06/2001	Biophysics
University of California at San Francisco, CA, USA	Internship	06/2002	Internal Medicine
University of California at San Francisco, CA, USA	Residency	06/2003	Internal Medicine
University of California, San Francisco, CA, USA	Fellowship	10/2006	Infectious Diseases
University of California, San Francisco, CA, USA	Postdoctoral Training	10/2008	Virology

A. Personal Statement

My research interests focus on the development of next-generation sequencing “omics” approaches for clinical validation of metagenomic sequencing assays for infectious disease diagnosis, microbiome and virome analyses, detection and discovery of emerging viral pathogens for outbreak and disease surveillance, and RNA host response transcriptome profiling for investigation of acute and chronic infection-associated syndromes. As the Director of the CLIA-certified UCSF Clinical Microbiology Laboratory, I lead implementation efforts to translate research assays into clinical Laboratory Developed Tests (LDTs) for eventual FDA regulatory approval. I also have bioinformatics expertise in the development, programming, and validation of computational pipelines for pathogen detection, algorithms for microbial NGS analysis, and development of RNA gene-based classification models using machine learning and artificial intelligence to diagnose infections. The scope of my lab's research encompasses 6 major aims: (1) validate and deploy metagenomic next-generation sequencing (mNGS) clinical testing for diagnosis of infectious diseases, (2) develop novel and improved diagnostic tests for Lyme disease and other tickborne infections, (3) characterize SARS-CoV-2 and COVID-related complications such as multisystem inflammatory syndrome of children (MIS-C) using genomic, transcriptomic, and antibody profiling studies, (4) use sequencing approaches to characterize novel and emerging outbreak-associated pathogens, (5) host response analysis using RNA sequencing (RNA-Seq) and machine learning based classifier models for differential diagnosis of infectious and non-infectious syndromes. My background spans a wide range of subject areas, including microbiology, infectious disease, microbiome and virome analyses, metagenomics, transcriptomics, virology, clinical epidemiology, and bioinformatics.

Ongoing projects that I would like to highlight include:

NIH U01AT0129930 Grant (Henrich, PI; Chiu, Co-Investigator) 9/1/24 – 9/1/28

Whole Body Deep Tissue Characterization of the Human Virome

NIH/NIAID 1R01ED019453 Grant (Abate, PI; Chiu, Co-Investigator) 9/1/23 – 8/31/27

Gigapixel Next-Generation-Sequencing: An Ultra-Sensitive Diagnostic for Infections of the CNS
Lyme Disease Clinical Trials Center (Chiu, PI) 11/8/22-11/8/26
 Bay Area Lyme Disease Foundation
Enroll Lyme disease patients in diagnostic and therapeutic trials and support clinical research studies on tickborne infections

Chan-Zuckerberg Biohub Investigator Award (Chiu, PI) 4/1/21-4/1/26
 Chan-Zuckerberg Biohub
Clinical deployment of omics and CRISPR technologies for precision infectious disease diagnosis

NIH/NICHD R33HD105618 Grant (Chiu, PI) 2/1/21-2/1/26
 National Institutes of Health
Discovery and clinical validation of host biomarkers of disease severity and multi-system inflammatory syndrome in children (MIS-C) with Covid-19

Abbott Pandemic Defense Coalition Grant (Chiu, PI) 1/1/24 – 12/31/25
 Abbott Laboratories, Inc.
Detection and discovery of emerging pathogens by metagenomic next-generation sequencing

Tick-borne Disease Research Program Award HT9425-24-1-0474 (Chiu, PI) 7/1/24-7/1/26
 US Department of Defense
Clinical Validation and Implementation of a Host-Pathogen-Based Diagnostic Assay for Early Lyme Disease and Other Tick –Borne Infections

Antimicrobial Resistance Leadership Group Grant 5UM1AI104681-13 (Baum, PI; Chiu, Co-Investigator) 6/1/13 – 11/30/26
 NIH/NIAID
Metagenomic next-generation sequencing for detection of causes of pneumonia in hospitalized patients

CDC Emergency Laboratory Capacity (ELC) Subcontract Award (Chiu, PI) 7/1/24-7/1/26
 California Department of Public Health (Heluna Health)
Metagenomic Next-Generation Sequencing for Infectious Disease and Public Health Surveillance of Emerging Pathogens

Key Relevant Citations:

- Loy CJ, Servellita V, Sotomayor-Gonzalez A, ..., Burns JC, **Chiu CY**, De Vlaminck I. Plasma cell-free RNA signatures of inflammatory syndromes in children. *Proc Natl Acad Sci U S A*. 2024 Sep 10;121(37):e2403897121. doi: 10.1073/pnas.2403897121. Epub 2024 Sep 6. PMID: 39240972; PMCID: PMC11406294.
- Benoit P, Brazer N, de Lorenzi-Tognon M, ..., Murray B, Miller S, **Chiu CY**. Seven-year performance of a clinical metagenomic next-generation sequencing test for diagnosis of central nervous system infections. *Nat Med*. 2024 Dec;30(12):3522-3533. doi: 10.1038/s41591-024-03275-1. Epub 2024 Nov 12. PMID: 39533109; PMCID: PMC11645279. *Nat Med*. 2024 Dec;30(12):3522-3533. doi: 10.1038/s41591-024-03275-1. Epub 2024 Nov 12. PMID: 39533109; PMCID: PMC11645279.
- Servellita V, Bouquet J, Rebman A, Yang T, Samayoa E, Miller S, Stone M, Lanteri M, Busch M, Tang P, Morshed M, Soloski MJ, Aucott J, **Chiu CY**. A diagnostic classifier for gene expression-based identification of early Lyme disease. *Commun Med (Lond)*. 2022 Jul 22;2:92. doi: 10.1038/s43856-022-00127-2. PMID: 35879995; PMCID: PMC9306241.
- Ng DL, Granados AC, Santos YA, ..., Miller S, Mason CE, **Chiu CY**. A diagnostic host response biosignature for COVID-19 from RNA profiling of nasal swabs and blood. *Sci Adv*. 2021 Feb 3;7(6):eabe5984. doi: 10.1126/sciadv.abe5984. PMID: 33536218; PMCID: PMC7857687.
- Wilson MR, Sample HA, Zorn KC, ..., Dominguez SR, Miller S, **Chiu CY**. Clinical Metagenomic Sequencing for Diagnosis of Meningitis and Encephalitis. *N Engl J Med*. 2019 Jun 13;380(24):2327-2340. doi: 10.1056/NEJMoa1803396. PMID: 31189036; PMCID: PMC6764751.

B. Positions, Scientific Appointments, and Honors

Positions:

9/2023-present	Co-Director, UCSF Lyme Clinical Trials Center
7/2022-present	Director, UCSF Clinical Microbiology Laboratory
4/2021-present	Chan-Zuckerberg Biohub Investigator

7/2019-present Professor, Laboratory Medicine and Medicine / Infectious Diseases
 7/2014-present Associate Professor, Laboratory Medicine and Medicine / Infectious Diseases
 10/2008-present UCSF QB3 (California Institute for Quantitative Biosciences) Investigator
 10/2008-present Associate Director, UCSF Clinical Microbiology Laboratory
 10/2008-10/2020 Director, UCSF-Abbott Viral Diagnostics and Discovery Center
 10/2008-7/2014 Assistant Professor, Laboratory Medicine and Medicine / Infectious Diseases
 12/2007-12/2019 Infectious Diseases Attending Physician, UCSF Mount Zion Hospital, CA, USA

Scientific Appointments:

2024-present Editor, Genome Medicine
 2021-present Editor, mBio
 2021-present Investigator, Abbott Pandemic Defense Consortium
 2015-2017 Member, American Academy of Microbiology Next-Generation Sequencing Colloquium
 2015-present Editor, Journal of Clinical Microbiology
 2013-2015 Member, FDA Panel on Multiplexed Technologies for Bloodborne Pathogen Screening
 2012-present Editor, PLoS ONE
 2008-present Editor, Biologicals
 2001-present Member, American Medical Association, Infectious Diseases Society of America, American Society for Microbiology

Licenses, Certification

2016-present Board Certification, Infectious Diseases, American Board of Internal Medicine
 2004-2009 Board Certification, Internal Medicine, American Board of Internal Medicine
 2002 Medical Licensure, Physician and Surgeon, State of California (License #A81358)

Honors

2025 Orbital Launch Winner, 3rd Annual Humans in Space Challenge, Boryung, Inc.
 2025 Luminary Award, Precision Medicine World Conference
 2024 Pan-American Society for Clinical Virology Ed Nowakowski Senior Memorial Clinical Virology Award
 2023 Gardner Lectureship Award by the European Society for Clinical Virology
 2023 American Society for Microbiology Award for Research or Leadership in Clinical Microbiology
 2022 Chan-Zuckerberg Biohub Investigator Award
 2020 Finalist, XPRIZE Rapid COVID Testing Competition
 2014 Harvard Medical School / Partners in Health Massachusetts General Hospital Distinguished Researcher Award in Lyme Disease
 1995-2000 Life and Health Medical Insurance Fund Fellowship Award
 1999 Sylvia Sorkin Greenfield Award for Excellence in Biophysics
 1992 Chinese-American Engineer and Scientists Association of Southern California Award
 1989-1992 UC Berkeley Chancellor's and Alumni's Scholarship
 1989 Westinghouse Science Talent Search Honors Group

C. Contributions to Science

1. I have been dedicated to science at an early age and have been motivated by a desire to translate scientific discoveries into the biomedical field. While still in high school, I was the lead investigator on a study published in *Science* that successfully identified a neuronal population of cells in the medial medulla of the brain that governed cataplexy, one of the cardinal manifestations of narcolepsy. My Ph.D. thesis work focused on the structure and function of viruses using 3D cryo-electron microscopy as a tool to study adenovirus and its interactions with monoclonal antibodies and receptors. After completing an MD/PhD at UCLA and an internal medicine residency and infectious diseases fellowship at UCSF, I did a postdoctoral fellowship in the laboratories of Dr. Joseph DeRisi and Don Ganem at UCSF. Since starting my laboratory in 2008 at UCSF, my research has focused on the use of metagenomic sequencing to discover and characterize novel and/or emerging viruses of humans, especially those associated with outbreaks.

- a. Siegel JM, Nienhuis R, Fahringer HM, Paul R, Shiromani P, Dement WC, Mignot E, **Chiu C**. Neuronal activity in narcolepsy: identification of cataplexy-related cells in the medial medulla. *Science*. 1991 May 31;252(5010):1315-8. doi: 10.1126/science.1925546. PMID: 1925546; PMCID: PMC8784798.
 - b. Stewart PL, **Chiu CY**, Huang S, Muir T, Zhao Y, Chait B, Mathias P, Nemerow GR. Cryo-EM visualization of an exposed RGD epitope on adenovirus that escapes antibody neutralization. *EMBO J*. 1997 Mar 17;16(6):1189-98. doi: 10.1093/emboj/16.6.1189. PMID: 9135136; PMCID: PMC1169718.
 - c. **Chiu CY**, Urisman A, Greenhow TL, Rouskin S, Yagi S, Schnurr D, Wright C, Drew WL, Wang D, Weintrub PS, Derisi JL, Ganem D. Utility of DNA microarrays for detection of viruses in acute respiratory tract infections in children. *J Pediatr*. 2008 Jul;153(1):76-83. doi: 10.1016/j.jpeds.2007.12.035. Epub 2008 Mar 7. PMID: 18571541; PMCID: PMC3174048.
 - d. Greninger AL, Naccache SN, Messacar K, Clayton A, Yu G, Somasekar S, Federman S, Stryke D, Anderson C, Yagi S, Messenger S, Wadford D, Xia D, Watt JP, Van Haren K, Dominguez SR, Glaser C, Aldrovandi G, **Chiu CY**. A novel outbreak enterovirus D68 strain associated with acute flaccid myelitis cases in the USA (2012-14): a retrospective cohort study. *Lancet Infect Dis*. 2015 Jun;15(6):671-82. doi: 10.1016/S1473-3099(15)70093-9. Epub 2015 Mar 31. PMID: 25837569; PMCID: PMC6027625.
2. A key focus of my laboratory is the development, validation, and implementation of metagenomic next-generation sequencing (mNGS) approaches for detection of infections in acutely ill patients.
- a. Servellita V, Sotomayor Gonzalez A, ..., Raborn RT, St George K, **Chiu CY**. Adeno-associated virus type 2 in US children with acute severe hepatitis. *Nature*. 2023 May;617(7961):574-580. doi: 10.1038/s41586-023-05949-1. Epub 2023 Mar 30. PMID: 36996871; PMCID: PMC10170441.
 - b. Gu W, Deng X, Lee M, Sucu YD, Arevalo S, Stryke D, Federman S, Gopez A, Reyes K, Zorn K, Sample H, Yu G, Ishpuniani G, Briggs B, Chow ED, Berger A, Wilson MR, Wang C, Hsu E, Miller S, DeRisi JL, **Chiu CY**. Rapid pathogen detection by metagenomic next-generation sequencing of infected body fluids. *Nat Med*. 2021 Jan;27(1):115-124. doi: 10.1038/s41591-020-1105-z. Epub 2020 Nov 9. PMID: 33169017; PMCID: PMC9020267.
 - c. Deng X, Achari A, Federman S, ..., Taveira N, R Hackett J Jr, **Chiu CY**. Metagenomic sequencing with spiked primer enrichment for viral diagnostics and genomic surveillance. *Nat Microbiol*. 2020 Mar;5(3):443-454. doi: 10.1038/s41564-019-0637-9.
 - d. Miller S, Naccache SN, Samayoa E, Messacar K, Arevalo S, Federman S, Stryke D, Pham E, Fung B, Bolosky WJ, Ingebrigtsen D, Lorizio W, Paff SM, Leake JA, Pesano R, DeBiasi R, Dominguez S, **Chiu CY**. Laboratory validation of a clinical metagenomic sequencing assay for pathogen detection in cerebrospinal fluid. *Genome Res*. 2019 May;29(5):831-842. doi: 10.1101/gr.238170.118. Epub 2019 Apr 16. PMID: 30992304; PMCID: PMC6499319.
3. Throughout the COVID-19 pandemic, my laboratory has been studying the disease by performing genomic, serologic, and phylogenetic analyses of SARS-CoV-2 variants and developing novel assays for diagnosis such as a CRISPR-Cas12 based assay that was granted Emergency Use Authorization by the FDA in July of 2020.
- a. Brazer N, Morris MK, Servellita V, Anglin K, Saldhi P, Garcia-Knight M, Bethancourt S, Sotomayor-Gonzalez A, Wang B, Foresythe A, Nguyen J, Gliwa AS, Pineda-Ramirez J, Sanchez RD, Zhang Y, Ott M, Wadford DA, Andino R, Kelly JD, Hanson C, **Chiu CY**. Neutralizing Immunity Induced Against the Omicron BA.1 and BA.2 Variants in Vaccine Breakthrough Infections. *J Infect Dis*. 2022 Nov 11;226(10):1688-1698. doi: 10.1093/infdis/jiac384. PMID: 36134603; PMCID: PMC9619439.
 - b. Servellita V, Syed AM, Morris MK, ..., Doudna J, Ott M, **Chiu CY**. Neutralizing immunity in vaccine breakthrough infections from the SARS-CoV-2 Omicron and Delta variants. *Cell*. 2022 Apr 28;185(9):1539-1548.e5. doi: 10.1016/j.cell.2022.03.019. Epub 2022 Mar 18. PMID: 35429436; PMCID: PMC8930394.
 - c. Deng X, Gu W, Federman S, du Plessis L, ..., Bonin B, Wadford DA, **Chiu CY**. Genomic surveillance reveals multiple introductions of SARS-CoV-2 into Northern California. *Science*. 2020

Jul 31;369(6503):582-587. doi: 10.1126/science.abb9263. Epub 2020 Jun 8. PMID: 32513865; PMCID: PMC7286545.

- d. Broughton JP, Deng X, Yu G, Fasching CL, Servellita V, Singh J, Miao X, Streithorst JA, Granados A, Sotomayor-Gonzalez A, Zorn K, Gopez A, Hsu E, Gu W, Miller S, Pan CY, Guevara H, Wadford DA, Chen JS, **Chiu CY**. CRISPR-Cas12-based detection of SARS-CoV-2. *Nat Biotechnol*. 2020 Jul;38(7):870-874. doi: 10.1038/s41587-020-0513-4. Epub 2020 Apr 16. PMID: 32300245; PMCID: PMC9107629.
4. We are using RNA host response profiling and metagenomic respiratory sequencing to identify viral pathogens and biomarkers of viral-induced inflammation. I am the PI of a multi-institutional PreVAIL project funded by NIH/NICHD to analyze samples from pediatric patients with COVID-19, multisystem inflammatory syndrome of children, and/or other hyperinflammatory syndromes to identify diagnostic RNA gene biomarkers from plasma, whole blood, and nasal swabs. We have also identified human endogenous retrovirus (HERV) involvement in inflammatory syndromes such as pulmonary arterial hypertension.
 - a. Tan JK, Servellita V, Stryke D, ..., de Lorenzi-Tognon M, Benoit P, **Chiu CY**. Laboratory validation of a clinical metagenomic next-generation sequencing assay for respiratory virus detection and discovery. *Nat Commun*. 2024 Nov 12;15(1):9016. doi: 10.1038/s41467-024-51470-y. PMID: 39532844; PMCID: PMC11558004.
 - b. Loy CJ, Sotomayor-Gonzalez A, Servellita V, ..., Rostad CA, De Vlaminc I, **Chiu CY**. Nucleic acid biomarkers of immune response and cell and tissue damage in children with COVID-19 and MIS-C. *Cell Rep Med*. 2023 Jun 20;4(6):101034. doi: 10.1016/j.xcrm.2023.101034. Epub 2023 Apr 21. PMID: 37279751; PMCID: PMC10121104.
 - c. Gould CV, Free RJ, Bhatnagar J, Soto RA, ... **Chiu CY**, Staples JE; Yellow Fever Vaccine Virus Transplant and Transfusion Investigation Team. Transmission of yellow fever vaccine virus through blood transfusion and organ transplantation in the USA in 2021: report of an investigation. *Lancet Microbe*. 2023 Sep;4(9):e711-e721. doi: 10.1016/S2666-5247(23)00170-2. Epub 2023 Aug 3. PMID: 37544313; PMCID: PMC11089990.
 - d. Saito T, Miyagawa K, Chen SY, ..., **Chiu CY**, Ariza ME, Rabinovitch M Upregulation of Human Endogenous Retrovirus-K Is Linked to Immunity and Inflammation in Pulmonary Arterial Hypertension. *Circulation*. 2017 Nov 14;136(20):1920-1935. doi: 10.1161/CIRCULATIONAHA.117.027589. Epub 2017 Sep 21. PMID: 28935667; PMCID: PMC5685911.
5. We are applying transcriptomic profiling by RNA-Seq and machine learning to identify RNA gene biomarkers that can be used to diagnose infection-associated chronic illnesses such as Lyme disease, chronic fatigue syndrome / myalgic encephalomyelitis, and/or long COVID.
 - a. Bouquet J, Li T, Gardy JL, Kang X, Stevens S, Stevens J, VanNess M, Snell C, Potts J, Miller RR, Morshed M, McCabe M, Parker S, Uyaguari M, Tang P, Steiner T, Chan WS, De Souza AM, Mattman A, Patrick DM, **Chiu CY**. Whole blood human transcriptome and virome analysis of ME/CFS patients experiencing post-exertional malaise following cardiopulmonary exercise testing. *PLoS One*. 2019 Mar 21;14(3):e0212193. doi: 10.1371/journal.pone.0212193. PMID: 30897114; PMCID: PMC6428308.
 - b. Bouquet J, Gardy JL, Brown S, ..., Moore R, **Chiu CY**, Patrick DM; Complex Chronic Disease Study Group. RNA-Seq Analysis of Gene Expression, Viral Pathogen, and B-Cell/T-Cell Receptor Signatures in Complex Chronic Disease. *Clin Infect Dis*. 2017 Feb 15;64(4):476-481. doi: 10.1093/cid/ciw767. PMID: 28172519; PMCID: PMC5850034.
 - c. Bouquet J, Soloski MJ, Swei A, Cheadle C, Federman S, Billaud JN, Rebman AW, Kabre B, Halpert R, Boorgula M, Aucott JN, **Chiu CY**. Longitudinal Transcriptome Analysis Reveals a Sustained Differential Gene Expression Signature in Patients Treated for Acute Lyme Disease. *mBio*. 2016 Feb 12;7(1):e00100-16. doi: 10.1128/mBio.00100-16. PMID: 26873097; PMCID: PMC4791844.

Complete List of Published Work in MyBibliography:

<https://www.ncbi.nlm.nih.gov/myncbi/charles.chiu.3/bibliography/public/>