Harvard Medical School
Curriculum Vitae

Date Prepared: November 1, 2021

Name: Eric Joseph Rubin

Education

1980	A.B. (*magna cum laude*)	Biochemical Sciences	Harvard College, Cambridge, MA
1990	M.D.	Medicine	Tufts University School of Medicine, Boston, MA
1990	Ph.D.	Microbiology and Molecular Biology (advisor: D. Michael Gill)	Tufts University Sackler School of Biomedical Sciences, Boston, MA

Postdoctoral Training

7/90-6/92	Intern/Resident	Internal Medicine	Massachusetts General Hospital (MGH), Boston, MA
7/90-6/92	Clinical Fellow	Medicine	Harvard Medical School (HMS), Boston, MA
7/92-6/97	Clinical and Research Fellow	Infectious Disease, and Microbiology and Molecular Genetics (advisor: John J. Mekalanos)	MGH/HMS

Faculty Academic Appointments

7/97-3/04	Instructor	Medicine	HMS
7/99-6/05	Assistant Professor	Immunology and Infectious Diseases	Harvard T.H. Chan School of Public Health (HSPH), Boston, MA
4/04-1/20	Assistant Professor	Medicine	HMS
7/05-6/08	Associate Professor	Immunology and Infectious Diseases	HSPH
7/08-6/14	Professor	Immunology and Infectious Diseases	HSPH
7/14-6/20	Irene Heinz Given Professor	Immunology and Infectious Diseases	HSPH

7/20-	Adjunct Professor	Immunology and Infectious Diseases	HSPH

Appointments at Hospitals/Affiliated Institutions

7/97-4/04	Clinical Assistant	Medicine	MGH
11/97-	Associate Physician	Infectious Diseases	Brigham and Women's Hospital (BWH), Boston, MA
4/04-9/10	Associate Member		Broad Institute of MIT and Harvard (Broad Institute), Cambridge, MA
9/10-	Senior Associate Member		Broad Institute
9/10-	Faculty	Graduate Program in Tropical Infectious Diseases	HMS/HSPH
9/17-	Faculty	Graduate Program in Bacteriology	HMS/HSPH

Other Professional Positions

2009-2014; 2016-	Scientific Advisory Board Member	TB Alliance, New York, NY	2 days per year
	2012-2014	Chair	
2014-	Scientific Advisory Board Member	Institut Pasteur Korea, Seongnam, South Korea	2 days per year

Major Administrative Leadership Positions

Local

2001-2013	Course Director, BPH 365, Virulence Factors of Mycobacteria	HSPH
2009-2020	Director, Infectious Disease Consortium	Harvard University
2013-2020	Course Director, MICROBI 302QC, Infectious Disease Bootcamp	HSPH
2015	Chair, Search Committee, Assistant Professor	HSPH
2017-2019	Co-Founder, Graduate Program in Bacteriology	HMS/HSPH
2018-2020	Chair, Department of Immunology and Infectious Diseases	HSPH
2019	Course Director, MPH 100E, Essential Concepts in Infectious Disease	HSPH

Committee Service

Local

2004-2020	Biological Sciences in Public Health Admissions Committee	HSPH
	2004-	Co-Chair
2009-2012		HSPH

	Subcommittee on Appointments, Reappointments and Promotions	
2016		Harvard University
	Search Committee for HMS Dean	
2018		Boston Children's Hospital, Boston, MA
	Search Committee, Chief of Infectious Disease	
2021		Boston Children's Hospital
	Search Committee, Chief of Infectious Disease	

National

2008-2010	Pathogen Functional Genome Resource Working Group	J. Craig Venter Institute, Rockville, MD
2013-	Scientific Advisory Board, COBRE program	Vermont Center for Immunobiology and Infectious Disease, University of Vermont, Burlington, VT
2014-2015	Chair, Division U	American Society for Microbiology, Washington, DC
2014-2018	Vice Chair, Systems Biology Steering Committee	National Institute of Allergy and Infectious Diseases (NIAID), Rockville, MD
2015-	Scientific Advisory Committee, TB Research Unit Program	Weill Cornell Medical School and Memorial Sloan Kettering, New York, NY
2015-	Scientific Advisory Committee, TB Research Unit Program	Boston University, Boston, MA, and Rutgers University, Newark, NJ

International

2009	Chair, Gordon Research Conference on	Oxford University, Oxford, England
2009	Tuberculosis Drug Development	
	Advisory Board, Department for Molecular Biomedical Research	Ghent University, Gent, Belgium
2009-	Scientific Advisory Board, Singapore-MIT Alliance for Research and Technology	National University of Singapore, Singapore
2013	Organizer, Tuberculosis: Understanding the Enemy Keystone Symposia	Keystone Symposia, Whistler, BC
2013-	Scientific Advisory Board, Structure-guided Drug Discovery Coalition	University of Toronto, Toronto, Canada
2016-	Chair, Scientific Advisory Board, SANTHE	University of KwaZuluNatal, Durban, South Africa
2018	Organizer, Tuberculosis: Translating Scientific Findings for Clinical and Public Health Impact Keystone Symposia	Keystone Symposia, Whistler, BC
2020-	International Committee of Medical Journal Editors	No headquarters, annual meeting in different cities

Professional Societies

1980-	Massachusetts Medical Society

1993-	American Society for Microbiology

Grant Review Activities

2003-2008	AIDS Discovery and Development of Therapeutics Study Section	National Institutes of Health (NIH) Permanent Member
	2007-2008	Chair
2013-2018	Science Interview Panel	Wellcome Trust Permanent Member
	2018	Chair
2016-2019	Microbiology and Infectious Diseases Study Section	NIH Permanent Member

Editorial Activities

Ad hoc Reviewer

Cell
Cell Host and Microbe
Journal of Bacteriology
Nature
Nature Medicine
Nature Microbiology
Proceedings of the National Academy of Science
Science

Other Editorial Roles

2002-2012	Board of Peer Reviewers	*UpToDate*
2007-2012	Section Editor	*Tuberculosis*
2008-2010	Associate Editor	*PLoS Pathogens*
2008-2012	Editorial Board	*Current Opinion in Microbiology*
2010-2012	Section Editor, Genomics Editor	*PLoS Pathogens*
2012-2019	Associate Editor	*New England Journal of Medicine*
2013-2019	Editorial Board	*MBio*
2019-	Editor-in-Chief	*New England Journal of Medicine*

Book/Textbook Editorial Roles

2015	Kaufmann SHE, **Rubin EJ**, Zumla A, editors.	*Tuberculosis*. Cold Spring Harbor Perspectives in Medicine. New York: Cold Spring Harbor Laboratory Press, 2015.

Honors and Prizes

1988	First Prize, Graduate Research	Tufts University	
1989	Alpha Omega Alpha	Tufts University School of Medicine	
1990	William Dameshek Award in Internal Medicine	Tufts University School of Medicine	Top student in medicine

1993	Physician Postdoctoral Fellow	Howard Hughes Medical Institute	
1995	Edward Kass Award	Massachusetts ID Society	Top infectious disease fellow
2003	Investigator in the Pathogenesis of Infectious Disease	Burroughs Wellcome Foundation	
2010	Division B Lecturer	American Society for Microbiology	
2012	Fellow	American Academy of Microbiology	
2019	Honorary Professor	University of KwaZulu-Natal	
2020	Member	American Academy of Physicians	
2021	Member	National Academy of Medicine	

Report of Funded and Unfunded Projects

Funding Information

Past

2001-2006 Virulence Factors in Mycobacteria
NIH/NIAID 1R01 AI048704
PI
The goal of this project was to use transposon site hybridization to determine genes required by *M. tuberculosis* for survival *in vitro* and *in vivo*.

2001-2007 Drug resistance in tuberculosis: genetic and dynamics
NIH/NIAID R01 AI051929
PI
The goal of this project was to investigate the molecular mechanisms of drug resistance and to study the population dynamics of *M. tuberculosis* (Mtb) during infection and drug treatment in a mouse model of TB.

2003-2008 Arming the Immune System Against Pathogens
NIH/NIAID P01 AI056296
Co-Investigator (PI: Laurie Glimcher)
The major goal of this project was to use transposon site hybridization to study virulence in *Francisella tularensis.*

2004-2010 Cell signaling by bacterial cytokines in *Mycobacterium tuberculosis*
Burroughs Wellcome Fund 1004475
PI
The goal of this project was to elucidate the role of a family of secreted proteins in regulating the growth of *M. tuberculosis*.

2006-2008 NERCE Developmental Grant Program
NIH/NIAID U54 AI057159
Co-Investigator (PI: Dennis Kasper)

The goal of this project was to identify the regulatory mechanisms involved in host adaptation, and genes required for infection.

2006-2009 Host Factors Involved in Mycobacterial Pathogenesis
NIH/NIAID R01 AI061609
Co-Investigator (PI: Norbert Perrimon)
The goal of this project was to study the interaction between pathogens and their host, with high-throughput genomic cells in *Drosophila* cells to study the mechanisms of bacterial uptake and intracellular survival.

2007-2010 Isolation and Properties of *M. tuberculosis* Persisters
Bill & Melinda Gates Foundation
PI
The major goal of this project was to develop methods to isolate and characterize a population of antibiotic-tolerant mycobacteria.

2007-2010 Probing *M. tuberculosis in situ* with Advanced Microscopy
Bill & Melinda Gates Foundation
PI
The major goal of this project was to use CARS and fluorescence microscopy to characterize the growth of mycobacteria in vitro and in vivo.

2007-2011 Integrated Methods for Tuberculosis
Bill & Melinda Gates Foundation Grant ID 42844
Co-Investigator (PI: David Sherman)
The goal of this project was to integrate cell-based and enzyme-based approaches for TB drug discovery.

2008-2010 New Diagnostics for TB
Howard Hughes Medical Institute
PI
The major goals of this project were to develop assays for candidate mycobacterial cell wall components as biomarkers of infection, and develop clinical and laboratory capacity to evaluate potential new tuberculosis diagnostic tests in Durban, South Africa.

2009-2012 Drug Targets for Tuberculosis
NIH/NIAID R01 AI071881
PI
The goal of this project was to characterize the role of essential genes in Mtb under various clinically relevant growth conditions *in vitro* and in a mouse model of TB, with the aim of enabling more rational selection of targets for treatment of tuberculosis.

2009-2014 *M. tuberculosis* Membrane Protein Pharmaceutical Targets
NIH/NIAID P01 AI074805
Co-Investigator (PI: Timothy Cross)
The goal of this project was to characterize essential membrane proteins and validate their potential as new drug targets.

2010-2011 Target Identification for Tuberculosis Drug Discovery
Bill & Melinda Gates Foundation OPP1024055
Co-Investigator (PI: James Sacchettini)

The goal of this project was to generate *M. tuberculosis* strains resistant to selected compounds in order to identify the targets.

2010-2016 Conditional *M. tuberculosis* knockdown mutants for TB drug development
Bill & Melinda Gates Foundation OPP1024065
Co-Investigator (PI: Dirk Schnappinger)
The goal of this project was to characterize the growth of conditional knockdown strains of Mtb, in order to evaluate prioritized proteins as new drug targets.

2011-2012 Acylated Immunogens Produced by Mycobacteria as a Potential Subunit HIV Vaccine
NIH/NIAID P30 AI060354 CFAR/Center for AIDS Research
Co-Investigator (PI: Bruce Walker)
The goal of this project was to clone the SIV gene sequences in pTet and express and purify the immunogens in *Mycobacterium smegmatis*.

2011-2013 *M. tuberculosis* NadD and NadR Target Validation
Vertex Pharmaceuticals Incorporated
PI
The goal of this project was to characterize and validate targets in NAD cofactor biosynthesis in Mtb.

2011-2013 A Small Animal Model for HIV/TB
NIH/NIAID P30 AI060354 CFAR/Center for AIDS Research
Co-Investigator (PI: Bruce Walker)
This project was to study HIV/TB co-infection in a humanized mouse animal model.

2011-2013 An integrated host and pathogen genetic strategy to elucidate the mechanism of action of BCG in therapy of Bladder Cancer
Broad Institute 5420300-5500000435
Co-Investigator (PI: Michael Glickman)
The goal of this project was to create a transposon mutant library in BCG to be screened in bladder cancer cell lines, in order to identify genes that play a role in the interaction between BCG and bladder cancer cells.

2011-2015 Structures of *Mycobacterium tuberculosis* proteins conferring susceptibility to known *M. tuberculosis* inhibitors
NIH/National Institute of General Medical Sciences U01 GM094568
Co-Investigator (PI: James Sacchettini)
The goal of this project was to create an overexpression library in mycobacteria, and measure growth rates by multiplex PCR and sequencing, and then perform growth rate screens with select compounds.

2012-2015 A genetic approach to understanding single cell heterogeneity in *M. tuberculosis*
KwaZulu-Natal Research Institute for Tuberculosis & HIV, No Award Number
PI
The major goal of this project was to identify genes that contribute to cell-to-cell variation in the response of Mtb to antibiotics.

2012-2019 A Community Mycobacterial Systems Resource
NIH/NIAID R01 AI097191
Co-Investigator (PI: Keith Derbyshire)

The goal of this project was to apply genomics and high throughput technologies to develop a Mycobacterial Systems Resource (MSR) that would provide a comprehensive, integrated genomic and visual summation of biological processes common to all mycobacteria. Specifically, we characterized target localization in the MSR mutant library.

2013-2019 Decoding the roles of critical genes of unknown function in *M. tuberculosis*
NIH/NIAID U19 AI107774
PI
The goal of this project was to apply functional genomics to understand the roles of unknown genes in Mtb.

2014-2015 Human TB Challenge Model Consortium
Aeras
Co-PI (Co-PI: Sarah Fortune)
The goal of this project was to produce safe bacterial strains for appropriate for use in a challenge model, and strains that can be used to measure bacterial burden in tissue.

2014-2016 Targeting Mycobacterial Mistranslation to Shorten TB Therapy Duration
Bill & Melinda Gates Foundation OPP1109789
Co-Investigator (PI: Babak Javid)
The goal of this project was to screen for compounds that decrease rates of mistranslation in Mtb, and to validate hits.

2014-2020 CETR: Discovery and validation of drug resistance mutations
NIH/NIAID U19 AI109755
Co-Investigator (PI: Megan Murray)
The goal of this project was to identify and characterize resistance-associated mutations in Mtb.

2015-2016 Vaccination against *Mycobacterium tuberculosis*
NIH/NIAID P30 AI060354
Co-Investigator (PI: Tomas Maira-Litran)
The goal of this project was to test the efficacy and safety of a vaccine candidate in the mouse model of TB.

2015-2017 Role of tuberculosinyl metabolites in *M. tuberculosis* virulence
NIH/NIAID R01 AI116604
Co-Investigator (PI: Branch Moody)
The major goal of this project was to study the non-redundant roles of TbAd in virulence by conducting genetic knockout and complementation in Mtb.

2015-2018 Fate of *M. tuberculosis* Antibiotic Survivors
NIH/NIAID R21 AI116142
MPI (MPI: Alexander Pym)
The goal of this project was to identify genetic mechanisms that contribute to antibiotic survival.

2016-2017 Mycobacterial strain development for human challenge
Bill & Melinda Gates Foundation OPP1135516
Co-PI (Co-PI: Sarah Fortune)

The goal of this project was to develop an attenuated strain of Mtb that could be considered for human challenge studies, and a reporter system for detection of the human challenge strain during infection.

2016-2019 Turning the tides against tuberculosis
Broad Institute
PI
The goal of this project was to characterize the role of the essential protease HtrA in Mtb.

2017-2019 Optimization and preclinical development of a TB Multiple Antigen Presenting System (MAPS) vaccine
NIH/NIAID R01 AI135720
Co-Investigator (PI: Richard Malley)
The goal of this project was to test vaccine candidates in a mouse model of TB.

2018-2019 BCG Panel Generation
Leidos Biomedical Research, Inc. 18X058Q
PI
The goal of this project was to construct strains of *Mycobacterium bovis* BCG that are conditionally replicating and evaluate them *in vitro*.

2020-2021 Genetics for Broad Flagship
Broad Institute 6230194-PO
PI
The goal of this project is to study the biology of TB treatment shortening, by identifying and characterizing synergistic target combinations.

Current

2012-2017; 2018-2023 Structure-based Discovery of Critical Vulnerabilities of Mycobacteria
NIH/NIAID P01 AI095208
Core Leader and Project Co-Investigator (PI: James Sacchettini)
The goal of the Core is to prioritize vulnerable targets, generate mycobacterial mutants for structure-function studies, identify small molecule inhibitors, and determine the targets of inhibitors via a variety of genetic and genomic approaches. The goal of Project 2 is to use structural approaches combined with chemical genomics to understand the fundamental biology of translation in Mtb and its modulation, and to identify the roles of small molecule inhibitors.

2014-2018; 2018-2021 NCE 2021-2022 Chemical Genomics of Tuberculosis
Bill & Melinda Gates Foundation OPP1084233
Co-Investigator (PI: Eric Lander)
The goal of this project is to generate depletion strains for essential genes in Mtb and perform *in vitro* and *in vivo* characterizations of these strains. Our primary aim is to create libraries of inducible depletion strains for essential targets, by applying advances we have made in mycobacterial recombineering and molecular barcoding.

2017-2019 NCE 2019-2021 Controlled Human Infection Model: detection of effect in NHPs
Bill & Melinda Gates Foundation OPP1180610
Co-PI (Co-PI: Sarah Fortune) ($580,102)

The goal of this project is to develop of a strain of *M. tuberculosis* (Mtb) that could be used for a human challenge model of tuberculosis. Our aims are to develop and validate an attenuated strain of Mtb that meets the safety requirements to be considered for human challenge studies, and highly sensitive reporter systems for detection of the challenge strain during infection, both systemically and intradermally.

2017-2023 Biochemical infrastructure for developing mycobacterial Clp inhibitors
Bill & Melinda Gates Foundation OPP1181211
PI ($422,346)
The goal of this project is to perform biochemical assays with components of the Clp proteolysis system in Mtb, to assess compounds for inhibition of this potential drug target.

2017-2020
NCE 2020-2021 Vulnerability of *M. tuberculosis* to partial gene inactivation
Bill & Melinda Gates Foundation OPP1182859
Co-Investigator (PI: Dirk Schnappinger)
The goal of this project is to use genetic interaction screens to rank vulnerability of Mtb targets for TB drug discovery.

2017-2021
NCE 2021-2022 Chemigenomic Drug Discovery for Tuberculosis
U.S. Department of Defense PR160865
PI ($6,945,260)
This project's goal is to leverage a new generation of genetic and chemical approaches to develop novel therapeutics for TB.

2018-2021 Bacterial Pathogenesis Initiative
Harvard Medical School – Deans of Faculty of Medicine
PI ($350,000)
The goal of this project is to develop organoid models of pathogenesis for TB.

2018-2023 Conditionally replicating *Mycobacterium tuberculosis* vaccines
NIH/NIAID R01 AI135629
Co-Investigator (PI: Sabine Ehrt)
This project's overall goal is to develop an effective live-attenuated whole cell vaccine for TB that mimics virulent Mtb in terms of antigenicity, grows for a defined number of generations, but then is rapidly and fully killed without the need for antibiotic treatment.

2019-2024 Development of a self-inactivating, highly effective TB vaccine
NIH/NIAID R01 AI143788
MPI (MPI: JoAnne Flynn) ($249,987)
The goal of this to generate and characterize candidate vaccine strains of *M. bovis* BCG that are conditionally replicating.

2019-2024 CETR: Modulation of Protein Production and Degradation as an Integrated Approach to Rapid Sterilization of Drug Sensitive and Resistant Mtb
NIH/NIAID U19 AI142735
Project Leader (PI: Nader Fotouhi)
The goal of this project is to discover inhibitors that target the Mtb ClpP1P2 protease. The aims are to determine the sequence determinants of Clp-inhibitory peptides, develop optimized mechanism-based peptide inhibitors, and identify non-peptidic analogues that act as Clp inhibitors.

2020-2022 Using genetics and multi-scale imaging to understand the mechanisms underlying mycobacteriophage host choice
NIH/NIAID R21 AI156772
PI ($275,000)
This grant aims to understand the molecular interactions that govern mycobacteriophage host specificity, which may help to enable the design of more effective and universal therapies for mycobacterial infections.

2020-2025 Pathway Analysis in Tuberculosis
NIH/NIAID P01 AI143575
Co-Investigator (PI: Sabine Ehrt)
The goal of this project is to define and characterize complexes necessary for cell division. We will investigate the relative roles of transcriptional and post-transcriptional regulation in divisome function, and characterize the links between cell division and metabolism.

Training Grants and Mentored Trainee Grants

2001-2024 The Graduate Program in Tropical Infectious Diseases (GPiTID)
NIH/NIAID T32AI049928
MPI 2019-2020 (MPI: Dyann Wirth)
The major goal is to train Harvard graduate students to advance scientific achievements toward the control of infectious diseases. My role is to mentor Harvard trainees with an interest in the treatment, molecular biology, and genetics of tuberculosis. I co-led the training program for 1½ years but remain as training faculty.

2017-2022 Graduate Program in Bacteriology (GPiB)
NIH/NIAID 1T32AI132120-01
Co-PI 2017-2019 (PI: Ann Hochschild)
I was one of the founders of the GPiB program, which is dedicated to training Harvard graduate students in Bacteriology. I stepped down when I took over the GPiTD training grant above but remain as training faculty.

Report of Local Teaching and Training

Teaching of Students in Courses

Harvard University Courses

2001-2013	Virulence Factors of Mycobacteria BPH 365 Medical and graduate students	HSPH 2 2-hr sessions per wk for 8 weeks
2013-2020	Infectious Disease Bootcamp MICROBI 302QC Graduate students	Harvard University 2 2-hr sessions during 1-week course
2019	Essential Concepts in Infectious Disease MPH 100E MPH students	HSPH 10 2-hr sessions

Clinical Supervisory and Training Responsibilities

1997-	Infectious Disease Consult Service Preceptor Medical students, residents	BWH 4-12 weeks per year; 4 weeks for the past several years

Laboratory and Other Research Supervisory and Training Responsibilities

1997-	Research supervision Graduate students, postdocs, fellows, research assistants, staff scientists	HSPH Daily mentorship for 12 months/year

Formally Mentored Harvard Medical, Dental and Graduate Students

2002-2007 Erik Hett, HSPH Class of 2007
Completed research in my laboratory for his dissertation. Published 6 manuscripts on cell wall biosynthesis and the role of resuscitation-promoting factors in cell division. Currently Senior Scientist at Biogen, Cambridge, MA.

2002-2008 Mary Farrow, HSPH Class of 2008
Completed research in my laboratory for her dissertation and published a manuscript characterizing an *in vivo* essential gene with a critical role in the function of a major facilitator superfamily pump. Currently Lead Product Manager at Tally, Inc, San Francisco, CA.

2003-2008 Mary Sloan Siegrist, HSPH Class of 2008
Completed research in my laboratory for her dissertation and published 3 manuscripts elucidating the role of the Esx-3 secretion system in iron acquisition. Currently Assistant Professor, University of Massachusetts, Amherst, MA.

2003-2009 Jeffrey Murry, HSPH Class of 2009
Completed research in my laboratory for his dissertation. Published 7 manuscripts, including transposon site hybridization – a powerful new genetic approach for mycobacteria. Currently Research Scientist at Gilead Sciences, Foster City, CA.

2005-2011 Michael Chao, HSPH Class of 2011
Completed research in my laboratory for his dissertation: “Post-transcriptional control of the essential autolysin RipA in *Mycobacterium tuberculosis*”. Published 9 manuscripts on this work studying cell wall biosynthesis, and data analysis methods for essentiality screens. Currently Program Manager at HSPH.

2008-2014 Amanda Martinot, HSPH Class of 2014
Completed research in my laboratory for her dissertation: “Mycobacterial Metabolic Syndrome: Triglyceride Accumulation Decreases Growth Rate and Virulence of *Mycobacterium tuberculosis*”. Published 4 manuscripts. Currently Staff Scientist, Beth Israel Deaconess Medical Center (BIDMC), Boston, MA.

2009-2012 Ravikiran Raju, HSPH Class of 2012
Completed research in my laboratory for his dissertation: “Where proteins go to die: Elucidating the physiological and therapeutic significance of the Clp protease complex in

Mycobacterium tuberculosis". Published 9 manuscripts primarily related to drug discovery for TB, including target discovery and validation. Currently Clinical and Research Fellow, Children's Hospital Medical Center, Boston, MA.

2009-2013 Jason Yanjia Zhang, HSPH Class of 2013
Completed research in my laboratory for his dissertation: "Turning the tide against TB: Remaking ineffective host defenses into mechanisms for tuberculosis control". Published 11 manuscripts on performance and analysis of gene essentiality and interaction studies, and revealing a protective role for Mtb tryptophan biosynthesis against CD4-T-cell-mediated killing. Currently Clinical and Research Fellow, Children's Hospital Medical Center, Boston, MA.

2009-2015 Karen Kieser, HSPH Class of 2015
Completed research in my laboratory for her dissertation: "Spatiotemporal Control of *Mycobacterium tuberculosis* Cell Wall Biogenesis by the Peptidoglycan Synthase PonA1". Published 7 manuscripts on mycobacterial cell growth and division. Currently Staff Scientist at Seres, Cambridge, MA.

2012-2018 Catherine Baranowski, HSPH Class of 2018
Completed research in my laboratory for her dissertation: "Peptidoglycan Synthesis and Rod Shape Maintenance in Mycobacteria". Published 6 manuscripts. Currently Staff Scientist at Inscripta, Inc, Boulder CO.

2013-2019 Skye Fishbein, HSPH Class of 2019
Completed research in my laboratory for her dissertation on translational regulation in mycobacteria. Published 1 manuscript, and 1 in preparation. Currently Postdoctoral Fellow, Washington University, St. Louis, MO.

2014-2018 Katherine Wu, HSPH Class of 2018
Completed research in my laboratory for her dissertation: "Functional characterization of an essential mycobacterial protease". Published 2 manuscripts, characterizing novel mycobacterial septal factors, and the essential protease HtrA. Currently Staff Writer, *The Atlantic.*

2016-2020 Chidiebere Akusobi, HSPH Class of 2020
Completed research in my laboratory for his dissertation on interrogating genetic diversity in *Mycobacterium abscessus* with transposon sequencing. Manuscript currently in preparation. Currently MD-PhD Student, Harvard Medical School.

2017- Francesca Tomasi, HSPH PhD Student
Currently doing dissertation research in my laboratory, studying mechanisms of action and synergy of drugs in Mtb. Project at least one first-author publication. Bachelor's Degree, University of Chicago.

2018- Harim Won, HSPH PhD Student
Currently doing dissertation research in my laboratory, studying the function of the essential Clp protease in Mtb. Project at least one first-author publication. Bachelor's Degree, University of Nebraska, Omaha.

2018- Kerry McGowen, HSPH PhD Student
Currently doing dissertation research in my laboratory, studying the role of biofilms in mycobacterial infections. Project at least one first-author publication. Bachelor's Degree, Washington and Jefferson College.

Dissertation Committees (partial list, all Harvard GSAS PhD students unless otherwise indicated)

Past

2012 Huiyi Chen, "System-Wide Studies of Gene Expression in *Escherichia coli* by Fluorescence Microscopy and High Throughput Sequencing"
2012 Christopher Ford, "The evolution of drug resistant *Mycobacterium tuberculosis*"
2012 Monica Markovski, "Bacterial cell wall synthases require outer membrane lipoprotein cofactors"
2012 Talia Ramsdell, "Molecular Motors of ESX-type Secretion Systems"
2013 Daria Van Tyne, "Identification and characterization of novel drug resistance loci in *Plasmodium falciparum*"
2014 Andrew Olive, "Immunity to *Chlamydia trachomatis* and Host-Pathogen Interactions During Infection"
2014 John P. Santa Maria, "Investigating Synthetic Lethal Interactions with the Wall Teichoic Acid Pathway of *Staphylococcus aureus*"
2015 Richa Gawande, Chair, "Investigating the Rates and Drivers of Drug Resistance in *Mycobacterium tuberculosis*"
2015 Lincoln Pasquina, "Discovery of a Small Molecule That Inhibits D-Alanylation of Teichoic Acids in *Staphylococcus Aureus*"
2016 Alexandra Cantley, "Uncovering Bacterial Metabolites Involved in Eukaryotic Development"
2016 Tony Jia, "Peptide-Assisted Nonenzymatic RNA Replication in Coacervate Droplets"
2016 Michelle Rooks, "Microbiome-Targeted Interventions for Colitis-Associated Bacteria"
2016 Alexandra Sakatos, "Beyond Mutation: Epigenetic Drivers of Phenotypic Diversity and Survival in Mycobacteria"
2016 Rachel Yunck, "Identification of MltG as a Potential Terminase for Peptidoglycan Polymerization in Bacteria"
2018 Perrine Marcenac, "Molecular and ecological factors modulating the fitness of *Anopheles gambiae* mosquitoes infected with *Plasmodium falciparum*"

Current

Jonah Larkins-Ford (Tufts University)
Nicoletta Commins
Joel Sher
Donavan Neo
Molly Sargen
Julia Page
Eddie Irvine
Alyson Warr

Other Mentored Trainees and Faculty

1999-2001 Su Chiang, PhD / Alliance Manager, Carb-X
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: first-authored peer-reviewed manuscript of mentored research.

2001-2004 Christopher Sassetti, PhD / Professor, University of Massachusetts Medical School, Worcester, MA
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple first-authored manuscripts of mentored research.

2001-2006 Sarah Fortune, MD / John LaPorte Given Professor and Chair, Immunology and Infectious Diseases, HSPH

Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple first-authored manuscripts of mentored research.

2001-2009 Meera Unnikrishnan, PhD / Associate Professor, University of Warwick, Coventry, United Kingdom
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple peer-reviewed manuscripts of mentored research.

2002-2005 Noman Siddiqi, PhD / Lab Director, HSPH
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple peer-reviewed manuscripts of mentored research.

2002-2007 Jyothi Rengarajan, PhD / Associate Professor, Emory University, Atlanta, GA
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple first-authored manuscripts of mentored research.

2003-2006 Jennifer Philips, MD, PhD / Co-Chief of Infectious Disease, Washington University School of Medicine, St. Louis, MO
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple first-authored manuscripts of mentored research.

2003-2008 Simon Dillon, PhD / Director Proteomics Core, BIDMC, Boston, MA
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: first-authored manuscript of mentored research.

2006-2011 Jun-Rong Wei, PhD / Research Scientist, HSPH
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple first-authored manuscripts of mentored research.

2007-2011 Babak Javid, PhD, MB BChir / Associate Professor, University of California San Francisco, San Francisco, CA
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: first-authored manuscript of mentored research.

2009-2013 Flavia Sorrentino, PhD / Senior Clinical Research Associate, UCB, Madrid, Spain.
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple peer-reviewed manuscripts of mentored research.

2009-2015 Alissa Myrick, PhD / Senior Research Officer, University of Cape Town, Cape Town, South Africa, *deceased*
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: peer-reviewed manuscript of mentored research.

2010-2011 Magnus Steigedal, PhD / Director, Norwegian University of Science and Technology, Trondheim, Norway
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple peer-reviewed manuscripts of mentored research.

2010-2013 Andrej Trauner, PhD / Project Manager, BioVersys AG, Basel, Switzerland
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple manuscripts of mentored research.

2010-2014 Amy Barczak, MD / Assistant Professor, HMS

Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple peer-reviewed manuscripts of mentored research.

2011-2016
Elizabeth Hesper Rego, PhD / Assistant Professor, Yale University, New Haven, CT
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: first-authored manuscript of mentored research, NIH/NIAID F32 Postdoctoral Fellowship.

2011-2017
Cara Boutte, PhD / Assistant Professor, University of Texas at Arlington, Arlington, TX
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: first-authored manuscript of mentored research, NIH/NIAID F32 Postdoctoral Fellowship.

2012-2013
Justin Pritchard, PhD / Assistant Professor, Pennsylvania State University, State College, PA
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: first-authored manuscript of mentored research.

2012-2015
Mohlopeni Jackson Marakalala, PhD / Faculty Member and Wellcome Trust Fellow, Africa Health Research Institute, Durban, South Africa
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: first-authored manuscript of mentored research.

2013-2017
Adam Yadon, PhD / Research Scientist, Gilead Sciences, Seattle, WA
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: first-authored manuscript of mentored research.

2014-2019
Jeffrey Wagner, PhD / Co-Founder and Scientific Director, SanaRx Biotherapeutics, Cambridge, MA
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple peer-reviewed manuscripts of mentored research.

2017-2018
Tyler Bold, MD, PhD / Assistant Professor, University of Minnesota, Minneapolis, MN
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: obtained a faculty position.

2017- Junhao Zhu, PhD / Postdoctoral Research Fellow, Department of Immunology and Infectious Diseases, HSPH
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: multiple peer-reviewed manuscripts of mentored research.

2018- Charles Dulberger / Postdoctoral Research Fellow, Department of Immunology and Infectious Diseases, HSPH
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: first-authored manuscript of mentored research.

2019- Mark Sullivan, PhD / Postdoctoral Research Fellow, Department of Immunology and Infectious Diseases, HSPH
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: Damon Runyon Postdoctoral Fellowship.

2019- Pankaj Pal, MD, PhD / Postdoctoral Research Fellow, Department of Immunology and Infectious Diseases, HSPH

Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: mentored research project is ongoing.

2019- Xin Wang, PhD / Postdoctoral Research Fellow, Department of Immunology and Infectious Diseases, HSPH
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: mentored research project is ongoing.

2019- Daisy Xiaoxi Ji, PhD / Postdoctoral Research Fellow, Department of Immunology and Infectious Diseases, HSPH
Career stage: postdoctoral associate. *Mentoring role*: research advisor.
Accomplishments: Helen Hay Whitney Foundation Postdoctoral Fellowship.

Local Invited Presentations

No presentations below were sponsored by outside entities.

2020 COUR program / Panelist
Office of the President, Harvard University (Virtual)

2020 HSPH/NEJM Forum – The Business of Public Health / Panelist for 3 different talks
Office of the Dean, HSPH (Virtual)

2020 How to get published / Weekly seminar
Infectious Disease Division, BWH

2020 The Road to Wuhan – and beyond / Departmental Seminar
Department of Immunology and Infectious Diseases, HSPH

2021 What we don't know about TB/ Departmental seminar
Department of Epidemiology, Harvard TH Chan School of Public Health, Boston, MA (Virtual)

2021 What do we know and how do we know it?/ Invited speaker
Medicine Grand Rounds, Brigham & Women's Hospital, Boston MA (Virtual)

2021 What do we know and how do we know it?/ Invited speaker
John B. Little Symposium, Harvard TH Chan School of Public Health, Boston, MA (Virtual)

Report of Regional, National and International Teaching and Presentations

Invited Presentations and Courses*

No presentations below were sponsored by outside entities.

**I have not kept records of meetings but would estimate that I have given an average of 5-8 national or international presentations annually for the past five years.*

Regional

2020 Covid-19: What do we know and how does that help? / Keynote speaker

Massachusetts Medical Society Annual Education Program Lecture, Waltham, MA (Virtual)

2020 The COVID-19 Magic 8 Ball: Where do we go from here? / Grand Rounds
Department of Medicine, Tufts Medical Center, Boston, MA (Virtual)

2020 Covid-19 / Keynote speaker
Tufts 2020 COVID-19 Research Symposium: Research, Policy, Solutions
Tufts University, Boston, MA (Virtual)

2020 Covid-19: Where are we now and where are we going / Invited speaker
Anaesthesiology Grand Rounds, Tufts Medical Center, Boston, MA

2020 The COVID-19 Magic 8 Ball: Where do we go from here? / Grand Rounds
Department of Medicine, University of Vermont, Burlington, VT (Virtual)

2021 Covid-19 – Where are we and where are we going / Annual Meeting Keynote Address
Massachusetts Chapter, American Lung Association, Boston, MA (Virtual)

2021 No title/ Tufts University School of Medicine Alumni Reunion
Tufts University School of Medicine, Boston, MA (Virtual)

2021 Public health student forum/ Keynote speaker
Intercollegiate Student Health Forum, Boston, MA (Virtual)

National

2020 One of these things is not like the other one / Seminar speaker
Department of Microbiology, University of Hawaii, Honolulu, HI (Virtual)

2020 Fireside discussion with Eric Rubin and Bob Gallo / Discussion participant
Annual Meeting, Global Virus Network, Baltimore, MD (Virtual)

2020 Covid-19: The convergence of infection and inflammation / Keynote speaker
American College of Rheumatology Annual Meeting, Washington, DC (Virtual)

2021 Public Interest and profit: Big pharma and the Covid-19 rollout/ Panelist
Robert Zicklin Center for Corporate Integrity, City University of New York,
New York, NY (Virtual)

2021 What have we learned about epidemics?/ Invited speaker
Inflammation: Shared Pathways in Diverse Diseases, CURA Foundation,
New York, NY

2021 Challenges for medical journals during the great pandemic of 2020/ panelist
STM Spring conference, Chicago, IL (Virtual)

2021 What have we learned from Covid-19 – the good and the bad and the TB/ Keynote speaker
Reimagining the Research Approach to Tuberculosis in Light of COVID, National Academy of Medicine, Washington DC (Virtual)

2021 Preclinical to clinical drug development for TB/ Invited speaker
Gates Global Grand Challenges Annual meeting, Seattle, WA (Virtual)

2022 (scheduled) Title TBA / Keystone Symposia: The future of TB research and control in an age of viral Pandemics / Keynote speaker
Keystone Symposia, Breckenridge, CO

International

2019 Making and breaking proteins in mycobacteria – the great LepA forward / Invited lecture
U.S.-Japan Cooperative Medical Sciences Program (USJCMSP) 21st International Conference On Emerging Infectious Diseases In The Pacific Rim, Hanoi, Vietnam

2020 Personalized Medicine / Panel Organizer
World Economic Forum, Davos, Switzerland

2020 Genetic tools for making better drugs and vaccines / Keynote speaker
Japan Society for Microbiology, Tokyo, Japan

2020 The Road from Wuhan / Grand Rounds
Department of Medicine, Nagoya University, Nagoya, Japan

2020 The Road from Wuhan / Grand Rounds
Department of Medicine, Hiroshima University, Hiroshima, Japan

2020 Covid-19: What do we know and how does that help? / Keynote speaker
CIDRI Annual Meeting, University of Cape Town, Cape Town, South Africa (Virtual)

2020 Covid-19 / Invited speaker
NEJM **医学前沿**（Yi Xue Qian Yan）， Shanghai, China (Virtual)

2020 What Have We Learned from COVID-19: Improving Scientific and Social Outcomes / Invited Lecture
University of São Paolo and Brazilian National Academy of Sciences, São Paolo, Brazil (Virtual)

2020 Proteolysis in pathogens / Invited speaker
EMBL Conference: SARS-CoV2: Towards a New Era in Infection Research, Heidelberg, Germany (Virtual)

2020 Conference Roundtable Discussion / Panelist
EMBL Conference: SARS-CoV2: Towards a New Era in Infection Research, Heidelberg, Germany (Virtual)

2020 Clinical Illness in COVID-19 – how does it inform what we should do?/ Invited speaker
US Embassy to South Africa, Pretoria, South Africa (Virtual)

2020 The COVID-19 Magic 8 Ball: Where do we go from here? / Invited speaker
Herchel Smith Symposium, University of Cambridge, Cambridge, UK (Virtual)

2020 Challenges and Opportunities for Scientific Journals in the Digital World: What Is Your Vision? / Panelist
European Society of Cardiology Congress, Amsterdam, the Netherlands (Virtual)

2020 The importance and challenges of disseminating accurate information during a pandemic / Panelist

	Cura Foundation and the Jerusalem Ethics Forum, Rome, Italy (Virtual)
2020	Outbreaks through the millenia / Invited speaker Tencent Conference, Tencent Holdings, Shanghai, China (Virtual)
2021	Novel approaches to managing TB/ Invited speaker 6th South African TB Conference, Cape Town, SA (Virtual)

Report of Clinical Activities and Innovations

Current Licensure and Certification

1992-	Licensed Physician, Massachusetts Board of Registration in Medicine

Practice Activities

1997-	Infectious Disease Attending Physician	BWH	4-12 weeks per year; 4 weeks for the past several years

Report of Technological and Other Scientific Innovations

Systematic identification of essential genes by in vitro transposon mutagenesis	US Patent 6207384, Patent Filed: Mar 26, 1999, Date of Patent: Mar 27, 2001. https://patents.justia.com/patent/6207384 The invention features a general system for the identification of essential genes in organisms, and has been widely applied to the discovery of novel target genes for antimicrobial compounds, as well as to the discovery of genes that enhance cell growth or viability.
Hyperactive mutants of Himar1 transposase and methods for using the same	US Patent 6368830, Patent Filed: Sep 27, 2000, Date of Patent: April 9, 2002. https://patents.justia.com/patent/6368830 These hyperactive Himar1 mutant transposases enabled sophisticated analysis of the biochemistry of mariner transposition, and improved efficiency of a variety of genetic manipulations involving transposition *in vivo* and *in vitro,* such as random mutagenesis or transgenesis, in a wide range of host cells.
Assay for identifying essential genes in mycobacteria	Publication: Sassetti CM**, Boyd DH, Rubin EJ. *Genes required for mycobacterial growth defined by high density mutagenesis*. Mol Microbiol 2003;48:77-84. My lab developed transposon site hybridization (TraSH) for use in mycobacteria, to identify essential genes. We have made subsequent advancements to methodology, particularly moving from hybridization to sequencing to identify transposon insertion sites, as well as advancements in data analysis to enable the identification of essential domains. This method, now called TnSeq, is used widely and routinely in the field, in labs throughout the world.
Targeting Clp protease in treatments for	US Patent 9925251, Patent Filed: Oct 19, 2012, Date of Patent: Mar 27, 2018. https://patents.justia.com/patent/9925251 This invention features demonstration of the ClpP protease as an attractive potential drug target in Mtb, and includes validated inhibitors. This work has led

Mycobacterium tuberculosis	to a number of drug discovery projects focused on Mtb ClpP in labs throughout the world, with whom we actively collaborate.

Report of Education of Patients and Service to the Community

Activities

2020 Biotechnology Program Lecture (via Zoom)
Brockton High School, Brockton MA (Virtual)

2021 Newton Public Schools Expert Advisory Panel
Newton, MA (Virtual)

Recognition

2019	Brockton native named editor-in-chief of NE Journal of Medicine (Press coverage)	Enterprise News: https://www.enterprisenews.com/news/20190623/brockton-native-named-editor-in-chief-of-ne-journal-of-medicine (Jun 23, 2019)
2019	New editor says NEJM's mission won't change, but its execution will (Interview)	Stat News: https://www.statnews.com/2019/09/23/new-editor-nejm-interview/ (Sep 23, 2019)
2020	The COVID-19 pandemic – emergence, interventions, and consequences (Press coverage)	Representative, of 65 stories: STAT: https://www.statnews.com/2020/05/04/coronavirus-lab-shutdowns-impact-on-scientists-research-delays/ (May 4, 2020) New York Times: https://www.nytimes.com/2020/06/27/world/europe/coronavirus-spread-asymptomatic.html (Jun 28, 2020)
2020	Testing, treatment and vaccines: Unpacking efforts to contain the coronavirus (Press coverage)	WBUR: https://www.wbur.org/onpoint/2020/04/10/containing-the-coronavirus-pandemic (Apr 10, 2020)
2020	Interview with NEJM Editor-in-Chief (Press coverage)	NEJM: https://www.youtube.com/watch?v=3MmPGkpa3Iw (Sep 28, 2020)
2020	NEJM Editorial: Dying in a Leadership Vacuum (Press Coverage)	Representative, of 56 stories: New York Times: https://www.nytimes.com/2020/10/07/health/new-england-journal-trump.html (Oct 6, 2020) CNN: http://us.cnn.com/2020/10/07/health/nejm-editorial-political-leadership-bn/index.html (Oct 7, 2020) NPR: https://www.npr.org/sections/coronavirus-live-updates/2020/10/08/921609669/in-rare-step-esteemed-medical-journal-urges-americans-to-vote-trump-out-of-offic (Oct 8, 2020) Axios: https://www.axios.com/new-england-journal-of-medicine-editor-on-landmark-election-editorial-1b32ec67-bcc0-4e4d-ae60-dca6c3c17bd2.html (Oct 8, 2020)

		Zeit Online: https://www.zeit.de/wissen/gesundheit/2020-10/eric-rubin-corona-usa-scheitern-donald-trump-us-wahl/komplettansicht (Nov 2, 2020)
2020	NEJM's Editor-in-Chief goes in-depth on COVID-19 vaccine (Press coverage)	ABC KAAL: https://www.youtube.com/watch?v=F7zljso2S2g (Dec 9, 2020)
2020	Mass. Doctors play key role in Pfizer vaccine heading (Press coverage)	NBC Boston: https://www.nbcboston.com/news/local/mass-doctors-playing-key-role-in-pfizer-vaccine-hearing/2253554/ (Dec 10, 2020)
2020	Member of FDA Advisory Panel, reviewing COVID-19 vaccine candidates (Press coverage)	Representative, of 36 stories: Bloomberg News: https://www.bloomberg.com/news/articles/2020-12-10/fda-advisers-scrutinize-pfizer-s-covid-shot-for-clearance-vote?srnd=politics-vp (Dec 10, 2020) NBC News: https://www.nbcnews.com/health/health-news/pfizer-s-covid-19-vaccine-receives-key-fda-panel-recommendation-n1250692 (Dec 10, 2020

Report of Scholarship

ORCID ID: https://orcid.org/0000-0001-5120-962X
*co-first author; **mentee is first, co-first, or last author

Peer-reviewed publications in print or other media

Research investigations

1. Popoff MR, **Rubin EJ**, Gill DM, Boquet P. Actin-specific ADP-ribosyltransferase produced by a Clostridium difficile strain. Infect Immun 1988;56:2299-306.
2. **Rubin EJ**, Gill DM, Boquet P, Popoff MR. Functional modification of a 21-kilodalton G protein when ADP-ribosylated by exoenzyme C3 of Clostridium botulinum. Mol Cell Biol 1988;8:418-26.
3. Chardin P, Boquet P, Madaule P, Popoff MR, **Rubin EJ**, Gill DM. The mammalian G protein rhoC is ADP-ribosylated by Clostridium botulinum exoenzyme C3 and affects actin microfilaments in Vero cells. EMBO J 1989;8:1087-92.
4. Dillon ST**, **Rubin EJ**, Yakubovich M, Pothoulakis C, LaMont JT, Feig LA, Gilbert RJ. Involvement of Ras-related Rho proteins in the mechanisms of action of Clostridium difficile toxin A and toxin B. Infect Immun 1995;63:1421-6.
5. Waldor MK, **Rubin EJ**, Pearson GD, Kimsey H, Mekalanos JJ. Regulation, replication, and integration functions of the Vibrio cholerae CTXphi are encoded by region RS2. Mol Microbiol 1997;24:917-26.
6. Akerley BJ, **Rubin EJ***, Camilli A, Lampe DJ, Robertson HM, Mekalanos JJ. Systematic identification of essential genes by in vitro mariner mutagenesis. Proc Natl Acad Sci U S A 1998;95:8927-32.
7. **Rubin EJ**, Lin W, Mekalanos JJ, Waldor MK. Replication and integration of a Vibrio cholerae cryptic plasmid linked to the CTX prophage. Mol Microbiol 1998;28:1247-54.
8. Lampe DJ, Akerley BJ, **Rubin EJ**, Mekalanos JJ, Robertson HM. Hyperactive transposase mutants of the Himar1 mariner transposon. Proc Natl Acad Sci U S A 1999;96:11428-33.
9. **Rubin EJ**, Akerley BJ, Novik VN, Lampe DJ, Husson RN, Mekalanos JJ. In vivo transposition of mariner-based elements in enteric bacteria and mycobacteria. Proc Natl Acad Sci U S A 1999;96:1645-50.

10. Sassetti CM**, Boyd DH, **Rubin EJ**. Comprehensive identification of conditionally essential genes in mycobacteria. Proc Natl Acad Sci U S A 2001;98:12712-7.
11. Akerley BJ, **Rubin EJ**, Novick VL, Amaya K, Judson N, Mekalanos JJ. A genome-scale analysis for identification of genes required for growth or survival of Haemophilus influenzae. Proc Natl Acad Sci U S A 2002;99:966-71.
12. Chiang SL**, **Rubin EJ**. Construction of a mariner-based transposon for epitope-tagging and genomic targeting. Gene 2002;296:179-85.
13. Sassetti CM**, Boyd DH, **Rubin EJ**. Genes required for mycobacterial growth defined by high density mutagenesis. Mol Microbiol 2003;48:77-84.
14. Sassetti CM**, **Rubin EJ**. Genetic requirements for mycobacterial survival during infection. Proc Natl Acad Sci U S A 2003;100:12989-94.
15. Fortune SM**, Solache A, Jaeger A, Hill PJ, Belisle JT, Bloom BR, **Rubin EJ**, Ernst JD. Mycobacterium tuberculosis inhibits macrophage responses to IFN-gamma through myeloid differentiation factor 88-dependent and -independent mechanisms. J Immunol 2004;172:6272-80.
16. Rengarajan J**, Sassetti CM, Naroditskaya V, Sloutsky A, Bloom BR, **Rubin EJ**. The folate pathway is a target for resistance to the drug para-aminosalicylic acid (PAS) in mycobacteria. Mol Microbiol 2004;53:275-82.
17. Agaisse H, Burrack LS, Philips JA, **Rubin EJ**, Perrimon N, Higgins DE. Genome-wide RNAi screen for host factors required for intracellular bacterial infection. Science 2005;309:1248-51.
18. Fortune SM**, Jaeger A, Sarracino DA, Chase MR, Sassetti CM, Sherman DR, Bloom BR, **Rubin EJ**. Mutually dependent secretion of proteins required for mycobacterial virulence. Proc Natl Acad Sci U S A 2005;102:10676-81.
19. Murry J**, Sassetti CM, Moreira J, Lane J, **Rubin EJ**. A new site-specific integration system for mycobacteria. Tuberculosis (Edinb) 2005;85:317-23.
20. Philips JA**, **Rubin EJ**, Perrimon N. Drosophila RNAi screen reveals CD36 family member required for mycobacterial infection. Science 2005;309:1251-3.
21. Rengarajan J**, Bloom BR, **Rubin EJ**. Genome-wide requirements for Mycobacterium tuberculosis adaptation and survival in macrophages. Proc Natl Acad Sci U S A 2005;102:8327-32.
22. Xie Z**, Siddiqi N, **Rubin EJ**. Differential antibiotic susceptibilities of starved Mycobacterium tuberculosis isolates. Antimicrob Agents Chemother 2005;49:4778-80.
23. Diaz R**, Siddiqi N, **Rubin EJ**. Detecting genetic variability among different Mycobacterium tuberculosis strains using DNA microarrays technology. Tuberculosis (Edinb) 2006;86:314-8.
24. Joshi SM, Pandey AK, Capite N, Fortune SM, **Rubin EJ**, Sassetti CM. Characterization of mycobacterial virulence genes through genetic interaction mapping. Proc Natl Acad Sci U S A 2006;103:11760-5.
25. Lane JM**, **Rubin EJ**. Scaling down: a PCR-based method to efficiently screen for desired knockouts in a high density Mycobacterium tuberculosis picked mutant library. Tuberculosis (Edinb) 2006;86:310-3.
26. Charity JC, Costante-Hamm MM, Balon EL, Boyd DH, **Rubin EJ**, Dove SL. Twin RNA polymerase-associated proteins control virulence gene expression in Francisella tularensis. PLoS Pathog 2007;3:e84.
27. Hett EC**, Chao MC, Steyn AJ, Fortune SM, Deng LL, **Rubin EJ**. A partner for the resuscitation-promoting factors of Mycobacterium tuberculosis. Mol Microbiol 2007;66:658-68.
28. Sebastian S, Dillon ST, Lynch JG, Blalock LT, Balon E, Lee KT, Comstock LE, Conlan JW, **Rubin EJ**, Tzianabos AO, Kasper DL. A defined O-antigen polysaccharide mutant of Francisella tularensis live vaccine strain has attenuated virulence while retaining its protective capacity. Infect Immun 2007;75:2591-602.
29. Farrow MF**, **Rubin EJ**. Function of a mycobacterial major facilitator superfamily pump requires a membrane-associated lipoprotein. J Bacteriol 2008;190:1783-91.
30. Hett EC**, Chao MC, Deng LL, **Rubin EJ**. A mycobacterial enzyme essential for cell division synergizes with resuscitation-promoting factor. PLoS Pathog 2008;4:e1000001.
31. Philips JA**, Porto MC, Wang H, **Rubin EJ**, Perrimon N. ESCRT factors restrict mycobacterial growth. Proc Natl Acad Sci U S A 2008;105:3070-5.

32. Rengarajan J**, Murphy E, Park A, Krone CL, Hett EC, Bloom BR, Glimcher LH, **Rubin EJ**. Mycobacterium tuberculosis Rv2224c modulates innate immune responses. Proc Natl Acad Sci U S A 2008;105:264-9.
33. Zolotarev AS, Unnikrishnan M, Shmukler BE, Clark JS, Vandorpe DH, Grigorieff N, **Rubin EJ**, Alper SL. Increased sulfate uptake by E. coli overexpressing the SLC26-related SulP protein Rv1739c from Mycobacterium tuberculosis. Comp Biochem Physiol A Mol Integr Physiol 2008;149:255-66.
34. Murry JP**, Pandey AK, Sassetti CM, **Rubin EJ**. Phthiocerol dimycocerosate transport is required for resisting interferon-gamma-independent immunity. J Infect Dis 2009;200:774-82.
35. Pandey AK, Raman S, Proff R, Joshi S, Kang CM, **Rubin EJ**, Husson RN, Sassetti CM. Nitrile-inducible gene expression in mycobacteria. Tuberculosis (Edinb) 2009;89:12-6.
36. Ranjbar S, Boshoff HI, Mulder A, Siddiqi N, **Rubin EJ**, Goldfeld AE. HIV-1 replication is differentially regulated by distinct clinical strains of Mycobacterium tuberculosis. PLoS One 2009;4:e6116.
37. Siegrist MS**, Unnikrishnan M, McConnell MJ, Borowsky M, Cheng TY, Siddiqi N, Fortune SM, Moody DB, **Rubin EJ**. Mycobacterial Esx-3 is required for mycobactin-mediated iron acquisition. Proc Natl Acad Sci U S A 2009;106:18792-7.
38. Dey S, Lane JM, Lee RE, **Rubin EJ**, Sacchettini JC. Structural characterization of the Mycobacterium tuberculosis biotin biosynthesis enzymes 7,8-diaminopelargonic acid synthase and dethiobiotin synthetase. Biochemistry 2010;49:6746-60.
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41. Hett EC**, Chao MC, **Rubin EJ**. Interaction and modulation of two antagonistic cell wall enzymes of mycobacteria. PLoS Pathog 2010;6:e1001020.
42. Hickman HD, Li L, Reynoso GV, **Rubin EJ**, Skon CN, Mays JW, Gibbs J, Schwartz O, Bennink JR, Yewdell JW. Chemokines control naive CD8+ T cell selection of optimal lymph node antigen presenting cells. J Exp Med 2011;208:2511-24.
43. Kim JH, Wei JR, Wallach JB, Robbins RS, **Rubin EJ**, Schnappinger D. Protein inactivation in mycobacteria by controlled proteolysis and its application to deplete the beta subunit of RNA polymerase. Nucleic Acids Res 2011;39:2210-20.
44. Wei JR**, Krishnamoorthy V, Murphy K, Kim JH, Schnappinger D, Alber T, Sassetti CM, Rhee KY, **Rubin EJ**. Depletion of antibiotic targets has widely varying effects on growth. Proc Natl Acad Sci U S A 2011;108:4176-81.
45. Akopian T, Kandror O, Raju RM, Unnikrishnan M, **Rubin EJ**, Goldberg AL. The active ClpP protease from M. tuberculosis is a complex composed of a heptameric ClpP1 and a ClpP2 ring. EMBO J 2012;31:1529-41.
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    Comment in: Warner DF, Mizrahi V. Complex genetics of drug resistance in Mycobacterium tuberculosis. Nat Genet 2013;45:1107-8.
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Narrative Report

I am an Associate Physician in the Infectious Disease division at BWH. Until recently, I was an Assistant Professor of Medicine at HMS and was also the Irene Heniz Given Professor of Immunology and Infectious Diseases at HSPH and Chair of the department. I am currently an Adjunct Professor at HSPH and also serve as the Editor-in-Chief of the *New England Journal of Medicine*. My principal effort is in basic research, though I have made significant contributions in other areas.

My lab primarily studies tuberculosis, largely, though not entirely, focusing on the causative organism, *Mycobacterium tuberculosis*. Our lab has made contributions to the understanding of this disease in several ways. First, we have developed many of the molecuar biologic approaches that are widely used in the field. These include the methods for making focused and random mutations in *M. tuberculosis*, collecting and analyzing large-scale data from genome-wide mutational experiments and methods to collect and analyze higher order image information for understanding bacterial growth and division. In particular, the transposon system that we developed and our contribution to the development of transposon sequencing (Tn-seq) have been widely adopted by bacteriologists studying a wide range of non-mycobacterial organisms. Much of our work has concentrated on understanding the fundamental cell biology of mycobacteria, which has contributed to a much better understanding of cell division and the biogenesis of the complex bacterial cell wall. We have delineated some of the pathways required in both the host and pathogen for disease to occur. We have studied how vaccines work and are currently trying to develop new vaccine candidates. Recently, we have broadened our work to include non-tuberculous mycobacteria, a neglected cause of chronic pulmonary infections that cause more disease than *M. tuberculosis* in the U.S. And much of our work focuses on antibiotics – how they work, how organisms develop resistance, and how we can identify new targets for the development of therapeutics. This work has led to several ongoing drug development projects that leverage our understanding of the underlying physiology. Our research has led to many publications and has been supported (and continues to be supported) by many granting agencies, and I have participated in and served as PI on several multicenter grants. In fact, collaboration is an important part of our research and I am proud to have worked with a group of labs for the last several years, including those led by former trainees. I have spoken at most major microbiology meetings and helped organize the major tuberculosis meetings. I also serve as an advisor for many national and international organizations that are devoted to tuberculosis research and drug development, often serving as chair. I have also been an editor at many microbiology journals and was elected a Fellow of the American Academy of Microbiology.

Since 1997 I have attended on the Infectious Disease consultation service at BWH, spending between 4 weeks and 3 months per year seeing patients. I occasionally see outpatients or supervise fellows in clinic. I have also attended in the Tuberculosis clinic. I also consult informally with several clinicians about complex mycobacterial cases. I was elected to the Association of American Physicians in 2020 and to the National Academy of Medicine in 2021. In 2012, I became an Associate Editor at the *New England Journal of Medicine*, and then became Editor-in-Chief in 2019. Although this is nominally a full time job, I have received permission to continue to attend and maintain a large research lab.

As a laboratory scientist, my major teaching role has been serving as mentor for the many trainees in the lab. I have advised thirteen PhD students, all of whom have continued in some scientific roles, and over twenty postdoctoral fellows along with several visiting scientists, the vast majority of whom have gone on to academic positions and become leaders in their own fields. I currently supervise three PhD students and six postdoctoral fellows. I have served and continue to serve on dozens of dissertation advisory committees, both at Harvard and elsewhere. I have also taught a variety of didactic courses to medical, graduate, and undergraduate students as well as CME courses for physicians. In addition, I have been deeply involved in graduate education on many fronts, including as an MD-PhD advisor, as a PI on the Graduate Program in Tropical Infectious Diseases training grant, and as a founder of the Graduate Program in Bacteriology. I am deeply involved in supporting research training and education in Africa and

serve on the advisory committees for two programs, one in Cape Town and the other a pan-African program, and am an Honorary Professor at the University of KwaZulu-Natal.

In my new role at the *Journal* I have had to decrease some of my activities, but I continue to be devoted to the lab and have continued to see patients and to teach.