NATIONAL ACADEMIES Sciences Engineering Medicine

Accelerating the Use of Pathogen Genomics and Metagenomics in Public Health

A Workshop

Health and Medicine Division
Board on Global Health | Forum on Microbial Threats

Workshop Attendee Packet
July 22-23, 2024

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About the Forum on Microbial Threats

The Forum on Microbial Threats of the National Academies of Sciences, Engineering, and Medicine (National Academies) was created in 1996 at the request of the Centers for Disease Control and Prevention and the National Institutes of Health to provide a structured opportunity for discussion and scrutiny of critical, and possibly contentious, scientific and policy issues related to research on and the prevention, detection, surveillance, and responses to emerging and reemerging infectious diseases in humans, plants and animals as well as the microbiome in health and disease. The Forum brings together leaders from government agencies, industry, academia, and nonprofit and philanthropic organizations to facilitate cross-sector dialogue and collaboration through public debate and private consultation to stimulate original thinking about the most pressing issues across the spectrum of microbial threats.

Despite decades of progress, the need for the Forum on Microbial Threats remains. Emerging and persistent problems such as Ebola, chikungunya, Zika, yellow fever, antibiotic resistance, and, in recent years, MERS and COVID-19 demonstrate how the issue of infectious threats is global and unrelenting. The drivers are ever more pervasive, and the consequences—human, social, and economic—loom larger than ever.

The Forum convenes several times each year to identify and discuss key problems and strategies in the area of microbial threats. To supplement the perspectives and expertise of its members, the Forum also holds public workshops to engage a wide range of experts, members of the public, and the policy community. All workshops are summarized in high quality scholarly workshop proceedings that are available for free download from the National Academies Press.

The Forum on Microbial Threats is part of the National Academies' Board on Global Health. For more information about the Forum, please visit our website: www.nationalacademies.org/microbialthreats

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The Forum greatly appreciates our sponsors that make intellectual and financial contributions to our work.

Highlights of Recent Publications

- Toward a Common Research Agenda in Infection-Associated Chronic Illnesses: Proceedings of a Workshop (2024)
- Applying Lessons Learned from COVID-19 Research and Development to Future Epidemics: Proceedings of a Workshop (2023)
- Accelerating the Development and Uptake of Rapid Diagnostics to Address Antibiotic Resistance: Proceedings of a Workshop (2023)
- The Role of Plant Agricultural Practices on Development of Antimicrobial Resistant Fungi Affecting Human Health: Proceedings of a Workshop Series (2023)
- Toward a Post-Pandemic World: Lessons from COVID-19 for Now and the Future: Proceedings of a Workshop (2022)
- Innovations for Tackling Tuberculosis in the Time of COVID-19: Proceedings of a Workshop (2022)
- Systematizing the One Health Approach in Preparedness and Response Efforts for Infectious Disease Outbreaks: Proceedings of a Workshop (2022)
- The Critical Public Health Value of Vaccines: Tackling Issues of Access and Hesitancy: Proceedings of a Workshop (2021)
- Vaccine Access and Hesitancy: Part One of a Workshop Series: Proceedings of a Workshop—In Brief (2020)
- Exploring the Frontiers of Innovation to Tackle Microbial Threats: Proceedings of a Workshop (2020)
- The Convergence of Infectious Diseases and Noncommunicable Diseases: Proceedings of a Workshop (2019)

One Health Action Collaborative

The Forum's One Health Action Collaborative (OHAC), led by Kevin Anderson, Ph.D., is an ad hoc activity that engages a community of participants who are interested in contributing to ongoing exploration and information sharing related to One Health topics. OHAC is committed to accelerating the implementation of a One Health approach in the field to counter microbial threats. Members include a subset of forum members and a diverse range of external stakeholders from multiple sectors and disciplines such as public health, animal health, plant pathology, agriculture, environment, biotechnology, and others. Drawing from the dynamic discussions over regular conference calls, OHAC advises on one health efforts that are internal and external to the National Academies through the publication of papers and the hosting of seminars. For more info, click here.

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Workshop Agenda

July 22-23, 2024
9:00 AM – 5:30 PM ET
Virtual webcast *or* in person at the Keck Center | Washington, DC | Keck 100

Day 1	
9:00 – 9:15 am	**Welcome Remarks, Workshop Overview, and Goals** David Blazes, Bill & Melinda Gates Foundation, *in person* *Chair, Workshop Planning Committee*
9:15 – 10:45 am	**Session 1: Current State of Pathogen Genomics/Metagenomics in the U.S. Public Health Enterprise** **Moderator:** David Blazes, Bill & Melinda Gates Foundation, *in person* **Current State of Pathogen Genomics in the U.S. Public Health System** Greg Armstrong, Ridgway Consulting, LLC, *in person* **Applications of Pathogen Genomics in Public Health – National Level** Duncan MacCannell, U.S. Centers for Disease Control and Prevention, *in person* **Applications of Pathogen Genomics in Public Health – State Level** Ruth Lynfield, Minnesota Department of Health, *in person* **Q&A**
10:45 – 11:00 am	**BREAK**
11:00 am – 12:30 pm	**Session 2: Applications in Early Warning and Preparedness – Panel Discussion** **Moderator:** Wondwossen Gebreyes, The Ohio State University, *in person* **Genomic Surveillance for Antimicrobial Resistance** Yvan Hutin, World Health Organization, *in person*

	Wastewater Surveillance Rob Knight, University of California San Diego, *virtual* **Genomic Sequencing to Inform Therapeutic Usage** Lisa Purcell, Third Rock Ventures, *in person* **Pathogen Genomics for Outbreak Epidemiology** Pardis Sabeti, Broad Institute, *virtual* **Applications of Pathogen Genomics in H5N1 Outbreak** Tavis Anderson, U.S. Department of Agriculture, *virtual* **Q&A**
12:30 – 1:30 pm	**LUNCH**
1:30 – 3:30 pm	**Session 3: Data Infrastructure, Interoperability, Classification, and Stewardship** **Moderator:** Ana Bento, Cornell University, *in person* **Current State of Infrastructure and Interoperability of Pathogen Genomics Data in the U.S.** Steve Sherry, National Institutes of Health, *in person* **Integration of Data Streams to Augment Genomic Data** Melissa Haendel**,** University of North Carolina, National COVID Cohort Collaborative, *virtual* **PHA4GE Data Standards System and Structure – Application in South Africa** Alan Christoffels, Public Health Alliance for Genomic Epidemiology, *virtual* **Data Processing Structures and Determining the Value of Sequenced Data** Kristian Andersen, Scripps Research, *virtual* **Q&A**
3:30 – 3:45 pm	**BREAK**
3:45 – 5:15 pm	**Session 4: Privacy, Ownership, and Democratization Considerations in the U.S. – Panel Discussion**

	Moderator: Dick Wilder, Georgetown University, *in person* **Considerations for Sovereignty and Governance of Pathogen Genomics Data on an International Scale** Alexandra Phelan, Johns Hopkins University, *in person* **Personal Privacy – Risk Mitigation Related to Human Genome Sequences in Data Sets** Claudia Emerson, McMaster University, *in person* **Data Policy and the Development of a Universal IRB** Ben Berkman, National Institutes of Health, *in person* **Democratization Efforts and Integration of Alternate Data Systems** Bronwyn MacInnis, Broad Institute, *in person* **Q&A**
5:15 – 5:30 pm	**Synthesis and Adjourn**
END OF DAY 1	

Day 2: Solutions	
9:00 – 9:15 am	**Welcome Remarks, Review of Day 1** David Blazes, Bill & Melinda Gates Foundation, *in person*
9:15 – 10:45 am	**Session 5: Identifying Gaps in Current Applications, Funding, and Research** **Moderator:** Liliana Brown, National Institutes of Health, *in person* **Applications for New Pathogen Detection and Limitations of Genomics Data** Charles Chiu, University of California San Francisco, *in person*

	Workforce Training Alli Black, Washington State Department of Health, *in person* **Gaps and Opportunities for Priority Investments** Heather Carleton, U.S. Centers for Disease Control and Prevention, *in person* **Q&A**
10:45 – 11:00 am	**BREAK**
11:00 am – 12:30 pm	**Session 6: Envisioning the Future of Pathogen Genomics – Presentation and Panel Discussion** **Moderator:** Larry Madoff, Massachusetts Department of Public Health; University of Massachusetts Chan Medical School, *in person* **Pathogen Genomics in the Future of Public Health:** Chikwe Ihekweazu, WHO, *virtual* **Panelists:** 1. Mike Worobey, University of Arizona, *virtual* 2. Courtney Lias, US Food and Drug Administration, *in person* 3. Sharon Peacock, University of Cambridge, *in person* 4. Barney Graham, Morehouse School of Medicine, *virtual* **Q&A**
12:30 – 12:45 pm	**Synthesis and Close**
END OF WORKSHOP	

Workshop Planning Committee

David Blazes, M.P.H., M.D., *(chair)*
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Independent Consultant, Ridgway Consulting, LLC

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Assistant Professor, Cornell University, College of Veterinary Medicine, Public and Ecosystem Health Department

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Deputy Director, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention

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Associate Professor and Carlton S. Wilder Chair, School of Civil and Environmental Engineering, Georgia Institute of Technology

Jill Taylor, M.S., Ph.D.,
Senior Advisor for Scientific Affairs, Association of Public Health Laboratories

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* Member, Forum on Microbial Threats

Planning Committee Member Biographies

David Blazes (chair)

David Blazes, MPH, M.D., joined the Global Health program at the Bill & Melinda Gates Foundation in May 2016 after serving as a physician epidemiologist in the Navy. His academic work has appeared in Science, Nature and the LancetID, and he edited a textbook on technological innovations in disease surveillance. He has previously served on the Institute of Medicine's Forum on Microbial Threats, the Infectious Disease Society of America's Global Public Health Committee/Pandemic Influenza Task Force and currently serves on the National Academy of Science's Board on Health Science Policy. At the foundation, David serves as Deputy Director for Genomics, Epidemiology and Modeling, and manages a portfolio around burden of disease modeling, geospatial mapping, and next generation genetic sequencing of pathogens with epidemic potential.

David graduated from the U.S. Naval Academy, did his medical training at Johns Hopkins University, and serves as an Adjunct Professor at the Uniformed Services University. Outside of work, he enjoys endurance running and cycling.

Gregory Armstrong

Gregory Armstrong, MD, is an infectious disease physician and medical epidemiologist with over 25 years of experience in public health. He held various positions at the US Centers for Disease Control and Prevention between 1997 and 2022 in areas such as infectious hepatitis, viral vaccine-preventable diseases, refugee health, polio eradication, and mathematical modeling of infectious diseases. He also played leadership roles in CDC's response to several large public-health emergencies, including the 2001 anthrax releases, the 2003 SARS outbreak, 2014-2016 West Africa Ebola outbreak, and the H1 influenza and COVID-19 pandemics. From 2015 until retirement, he was the inaugural director of the agency's Advanced Molecular Detection Program, focused on bringing modern pathogen genomics into the US public health system. Since retirement from CDC, Dr. Armstrong has worked as an independent consultant for a variety of entities, including in the private sector, non-profits, and the World Health Organization. He has particular expertise in the practical applications of genomic technologies to public health, both domestically and internationally. Dr. Armstrong is a Fellow of the Infectious Disease Society of America.

Ana Bento

Ana Bento, Ph.D., is an assistant professor of Infectious disease ecology in the College of Veterinary Medicine at Cornell University. Prior to joining Cornell, she was the director of Science at the Pandemic Prevention Institute of the Rockefeller foundation where she lead a transdisciplinary team to develop analytics and models for pandemic response and the expansion of climate sensitive diseases. She earned her Ph.D. in Ecology & Evolution at Imperial College London. After a MRC postdoctoral fellowship (2013-2015) at Imperial College, Infectious Diseases Epidemiology Department, she took a postdoctoral position at UGA, on the ecology & evolution of vaccine preventable childhood diseases (2015-2019).

Her transdisciplinary research program research program leverages mathematical and computational modeling, machine learning, to identify the eco-evolutionary, demographic, and environmental drivers of pathogen emergence, persistence, and spread. With her research Dr Bento seeks to understand the dynamics of biological populations and epidemics, focusing on how to bring experimental and observational data together with mathematical theory. Tackling biological questions of public application and importance. Her work focuses on understanding fundamental processes in ecology and evolution. The lab ongoing research falls into the following themes: (i) pathogen evolution and phylodynamics; (ii) seasonal disease transmission; (iii) anthropogenic effects (e.g. vaccines); (iv) adaptive behavior. With these methods her lab makes quantitative, testable predictions and confront process-based models to advice public health policy and implementation. During the SARS-CoV -2 pandemic she has both national and international advisory

roles, among others, she was a member of the WHO Technical advisory group for COVID-19 and Schools and she advised the Big10 varsity teams in the US on testing.
Dr Bento is an elected committee member of MIDAS (NIH), was the chair of the disease Ecology section of the Ecological Society of America (2020-2022) and a member of the International Bordetella Society. She is also a member of R-Ladies global.

Christopher Braden

Christopher Braden, M.D., is Deputy Director of National Center for Emerging and Zoonotic Infectious Diseases at the Centers for Disease Control and Prevention. Between 2010 and 2016, he was the Director of the Division of Foodborne, Waterborne and Environmental Diseases. Previously, he served and the Associate Director for Science in the Division of Parasitic Diseases, and chief of outbreak response and surveillance in the Division of Foodborne, Bacterial and Mycotic Diseases. From 1993 to 2000, he was an EIS officer then medical epidemiologist in the Division of Tuberculosis Elimination. During his tenure, Dr. Braden has held incident management leadership positions on multiple CDC responses to national and international outbreaks, including several nation-wide foodborne outbreak investigations, SARS, anthrax attacks in 2001, Ebola outbreaks in Western African and Congo, and the COVID-19 pandemic. His major areas of interest include molecular epidemiology of infectious diseases, infectious diseases surveillance and outbreak investigation and national programs in food safety. In addition to his duties at CDC, Dr. Braden maintained clinical infectious diseases activity by continuing work as an attending physician at the Tuft's University New England Medical Center until 2000, at the Fulton County TB clinic until 2005, and then as a Kaiser Permanente consulting physician until 2016. Dr. Braden received his Bachelor of Science from Cornell University, and his MD at the University of New Mexico School of Medicine. He completed his internship and residency in internal medicine then fellowship in infectious diseases at Tufts New England Medical Center in Boston, MA. He is Board Certified in infectious diseases. He joined CDC as an EIS Officer in 1993 and served as a commissioned officer in the US Public Health Service for over 20 years. He is a member of the Infectious Diseases Society of America, the American Epidemiological Society and an associate editor for the Emerging Infectious Diseases (EID) Journal.

Rick A. Bright

Rick Bright, Ph.D., is an international subject matter expert in biodefense, emergency preparedness and response, pharmaceutical innovation, vaccine, drug and diagnostic development. He is currently an advisor to numerous public and private organizations, an Executive Board Member for the NY Academy of Science's International Science Reserve, on the Board of Directors of FIND Dx, a member of the Science and Technical Advisory Board of the 100 Day Mission, a Sr. Fellow at the Foreign Policy Association, and a member of the Council on Foreign Relations.

Prior, Dr. Bright served as the Deputy Assistant Secretary for Preparedness and Response and the Director of the Biomedical Advanced Research and Development Authority (BARDA), in the U.S. Department of Health and Human Services where he directed public-private partnerships that led to the FDA approval of over 60 new vaccines, drugs, and diagnostics for public health and national security threats. Dr. Bright has extensive experience in the biotechnology industry where he held senior leadership and executive management roles. He has also held senior scientific leadership positions in non-governmental organizations where he championed innovative vaccine development and expanded vaccine manufacturing capacity to multiple developing countries. He also spent a decade in vaccine, therapeutics, and diagnostics development at the U.S. Centers for Disease Control and Prevention. For this work, Dr. Bright received the Charles C. Shepard Science Award for Scientific Excellence.

Dr. Bright received a Ph.D. in Immunology and Molecular Pathogenesis from Emory University and a B.S. magna cum laude with honors in Biology and Physical Sciences from Auburn University at Montgomery.

Liliana Brown

Liliana Brown, Ph.D., is Office Director for the Office of Genomics and Advanced Technologies (OGAT) in the Division of Microbiology and Infectious Diseases at the National Institute of Allergy and Infectious Diseases (NIAID). OGAT directs from programs in Structural Biology, Systems Biology, Bioinformatics and Omics technologies for Infectious Diseases. The OGAT programs bring together scientist from

microbiology, immunology, infectious diseases medicine, genomics, microbiome, physics, bioinformatics, computational biology, statistical methods, and mathematical modeling to integrate large-scale experimental biological and clinical data across temporal and spatial scales to accelerate technology development and to better understand infectious diseases. Dr. Brown has experience in omics of infectious diseases and computational biology through her academic career at Trinity DC University and research at the J. Craig Venter Institute (JCVI). Prior to joining NIAID, Dr. Brown was Associate Director of Scientific Affairs at the Society for Women's Health Research, a non-profit advocacy group in Washington, DC. Dr. Brown has a strong commitment to Diversity, Equity, Inclusion and Accessibility as a member of working groups at NIAID and at NIH, and through her Adjunct Faculty Position at the Goucher College Prison Education Partnership. Dr. Brown received her PhD in Molecular and Cell Biology at the University of Maryland College Park.

Wondwossen A. Gebreyes

Wondwossen Gebreyes, D.V.M., Ph.D., is a Hazel C. Youngberg Distinguished tenured and active Full Professor and Executive Director of the Global One Health initiative (GOHi) at The Ohio State University. Dr. Gebreyes has been a leader in molecular epidemiology of infectious zoonotic diseases. He led several programs funded through the NIH, CDC, USAID, Gates Foundation, CDC Foundation, RESOLVE to Save Lives among others. Besides research, he led global capacity building efforts teaching molecular epidemiology in more than 10 countries and also establishing genomic and genotyping laboratory capacities. Dr. Gebreyes serves in national and international Advisory capacities for various governments and entities including Brazil CAPES, Ethiopian Ministry of Science and Higher Education as well as review panels for Austria, Poland, and Qatar among others. Dr. Gebreyes leads global outreach efforts addressing issues at the interface of Humans, animals, plants and the environment (ICOPHAI). Dr. Gebreyes is a recipient of the APLU Michael P. Malone International Leadership Award; NIH Gold Medallion; Universitas 21 Best Internationalization Model; NC State University Distinguished Alumni award; Andrew Heiskell Award (honorable mention) by the Institute of International Education (IIE). Dr. Gebreyes is a member of the National Academy of Medicine; also inducted as inaugural member of the National Academy of International Education.

Sam Halabi

Sam Halabi, J.D., M.Phil., is a Professor in Georgetown University's School of Health and directs the Center for Transformational Health Law at the O'Neill Institute for National and Global Health Law. Prof. Halabi previously served as the senior associate vice-president for Health Policy and Ethics in Colorado State University's Office for the Vice-President of Research and as a professor at the Colorado School of Public Health. In 2018, he served as the Fulbright Canada Research Chair in Health Law, Policy, and Ethics at the University of Ottawa. He has published five books and more than 80 manuscripts in the fields of data sharing, the development and deployment of vaccines in routine and emergency circumstances, and public health law. He holds a J.D. from Harvard, an M.Phil. from the University of Oxford, and undergraduate degrees from Kansas State University.

Lawrence Madoff

Larry Madoff, M.D., is an infectious disease physician specializing in the epidemiology of emerging pathogens, bacterial pathogenesis, and international health. He is Professor of Medicine at the University of Massachusetts Chan Medical School and Lecturer on Medicine at Harvard Medical School. Dr. Madoff serves as Medical Director of the Bureau of Infectious Disease and Laboratory Sciences for the Massachusetts Department of Public Health. He is an attending on the inpatient infectious disease service at UMass Memorial Medical Center. He is co-Principal Investigator for the New England Pathogen Genomics Center of Excellence.

Dr. Madoff directed the Program for Monitoring Emerging Diseases (ProMED), from 2002 to 2021 and is Editor Emeritus. He is a member of the Massachusetts Medical Society, past President of the U.S. Lancefield Streptococcal Research Society, a Fellow of the Infectious Diseases Society of America and a Fellow of the American College of Physicians. A graduate of Yale College and Tufts Medical School, he performed his Internal Medicine Residency at New York Hospital-Cornell Medical Center and his Infectious

Disease Fellowship at the Harvard Medical School-Longwood program. Dr. Madoff is the recipient of the 2021 D.A. Henderson Award for Outstanding Contributions to Public Health from the Infectious Disease Society of America.

Ameet Pinto

Ameet Pinto, Ph.D., is an Environmental Engineer and Carlton S Wilder Associate Professor in Civil and Environmental Engineering at Georgia Institute of Technology (Georgia Tech). Ameet is a Chemical Engineer from Institute of Chemical Technology (University of Mumbai) with post-graduate degrees in Environmental Engineering from the University of Alaska (2005) and Virginia Tech, USA (2009). Their research focuses on the development and application of state-of-the-art molecular and modelling tools to monitor and manage the microbiology of the built environment. Their research has received support through prestigious grants and awards like EPSRC's Bright IDEAS Award in 2015, the NSF CAREER and ISME/IWA Rising Star Awards in 2018, 2019 Paul L Busch Award for Innovation in Applied Water Quality Research and the IWA MEWE Mid-Career Award in 2023.

Jill Taylor

Jill Taylor, Ph.D., received her Ph.D. in Microbiology from the University of Queensland, Australia. Her early work was in industry, in the development of recombinant veterinary vaccines. In 1999, she joined the Wadsworth Center, New York's State Public Health Laboratory as Director of the Viral Genotyping Laboratory and in 2002, the Director of the Clinical Virology program. Jill became Deputy Director of the Wadsworth Center in 2005, and Director in 2014. As Director, Jill coordinated the laboratory's response to the COVID-19 pandemic in New York State. In October 2020, she joined the Association of Public Health Laboratories as Senior Adviser for Scientific Affairs. Jill currently serves on the Advisory Committee to the Director of CDC and co-Chaired the Laboratory Workgroup. Her scientific interests are in novel, point-of-use and home-use technologies, genomic analyses and information technologies to improve the nation's public health response to emergent pathogens and bring care closer to the community.

Speaker Biographies

Kristian Andersen

Kristian Andersen, Ph.D., is a Professor at Scripps Research and Director of Infectious Disease Genomics. Over the past decade, he has spearheaded large international collaborations investigating the emergence, spread and evolution of viral pathogens, including SARS-CoV-2, Zika virus, Ebola virus, West Nile virus, and Lassa virus. Kristian earned his PhD in immunology from the University of Cambridge and performed postdoctoral work in virus genomics at Harvard University and the Broad Institute. Learn more about his work here: https://andersen-lab.com

Tavis Anderson

Tavis Anderson, Ph.D., is a Research Biologist at the National Animal Disease Center (Agricultural Research Service, United States Department of Agriculture). His research combines computational and experimental studies to understand how RNA viruses evolve as they are transmitted between hosts and across landscapes. Current research includes the identification of genetic predictors of influenza host range, the use of sequence data to understand the antigenic variability of influenza in swine, and the application of these results in vaccine development. An additional research focus is the development of algorithms that quantify the diversity of RNA viruses, and the curation of genetic sequence data in online databases with associated near real-time epidemiology tools.

Benjamin Berkman

Benjamin Berkman, J.D., M.P.H, is a faculty member in the NIH Department of Bioethics where he is the head of the section on the ethics of genetics and emerging technologies. He has a joint appointment in the National Human Genome Research Institute, where he serves as the Deputy Director of the NHGRI Bioethics Core. He was formerly the Deputy Director of the O'Neill Institute for National and Global Health Law at Georgetown Law (2007-2009), where he continues to serve as an Adjunct Professor. Mr. Berkman received a Bachelors Degree in the History of Science and Medicine at Harvard University (1999). He subsequently earned a Juris Doctor and a Masters in Public Health from the University of Michigan (2005). As a faculty member in the Department of Bioethics, Mr. Berkman's research interests span a wide range of topics. His current work focuses on the legal and ethical issues associated with genomic research, genetic information privacy, and clinical adoption of new genetic and reproductive technologies.

Alli Black

Alli Black, M.S, Ph.D., is a genomic epidemiologist passionate about integrating pathogen genomic analysis into public health practice, a domain she explores deeply as Senior Epidemiologist leading the Molecular Epidemiology Program at the Washington State Department of Health. Her experience in academic genomic epidemiology includes designing and conducting field-based studies of Zika virus in Colombia and the United States Virgin Islands, and supporting Ebola virus genomic surveillance in the Democratic Republic of the Congo. She has also performed programmatic work, helping CDC's Office of Advanced Molecular Detection develop recommendations for designing an open pathogen genomic analysis ecosystem for public health. During the pandemic, she helped local health jurisdictions across California develop the capacity to sequence and use SARS-CoV-2 genomic data to understand disease transmission. Now, as Director of the CDC-funded Northwest Pathogen Genomics Center of Excellence, she draws on her background in academia and public health to lead a collaborative group of government and academic partners working to translate cutting edge sequencing and genomic analysis approaches into applied public health.

Heather Carleton

Heather Carleton, MPH, Ph.D., currently serves as the chief of the Enteric Diseases Laboratory Branch (EDLB) in the Division of Foodborne, Waterborne and Environmental Diseases at the US Centers for

Disease Control and Prevention (CDC). Her expertise lies in the field of enteric diseases, molecular epidemiology, bioinformatics, and next generation sequencing. Dr. Carleton received her Doctor of Philosophy (PhD) in Microbial Pathogenesis from Yale University, Master of Public Health (MPH) in Infectious Diseases from the University of California, Berkeley and Bachelor of Science (BS) in Microbiology from the University of Michigan.

In 2012, Dr. Carleton joined CDC as an infectious diseases postdoctoral fellow. Since then, she has made significant contributions to public health through her work at EDLB. As Chair of the PulseNet USA and PulseNet International networks, she and her branch play a crucial role in connecting foodborne, waterborne, and One Health-related illness cases using genomics. PulseNet USA is a national laboratory network that aids in identifying and responding to enteric disease outbreaks.

Under Dr. Carleton's leadership, EDLB focuses on various aspects related to enteric diseases including prevention strategies, antimicrobial resistance studies, bioinformatics analysis, metagenomics methods development, and next-generation sequencing technologies. Her branch conducts cutting-edge research to better understand these diseases and develop effective interventions.

For more information about Dr. Heather Carleton's work or the Enteric Diseases Laboratory Branch at CDC, you can visit their website at www.cdc.gov/pulsenet.

Charles Chiu

Charles Chiu, M.D., Ph.D., is Professor of Laboratory Medicine at University of California, San Francisco and Director of the UCSF Clinical Microbiology Laboratory. Dr. Chiu leads a translational research laboratory focused on discovery and characterization of emerging viral pathogens and development of clinical metagenomic next-generation sequencing and host response profiling assays for diagnosis of infections. His work is currently supported by funding from the NIH, CDC, Chan-Zuckerberg Biohub, and Abbott Laboratories. Dr. Chiu has authored more than 200 peer-reviewed publications, is a co-founder of Delve Bio, and serves on the scientific advisory board of Biomeme, BiomeSense, Mammoth Biosciences, and FlightPath Biosciences

Alan Christoffels

Alan Christoffels, Ph.D., is the director of the South African National Bioinformatics Institute (SANBI) based at the University of the Western Cape. He is also the director of the SA Medical Research Council Bioinformatics Unit. For the past 10 years he has been the DST/NRF Research Chair in Bioinformatics and Health Genomics. His research lab focuses on infectious diseases and specifically building computational tools for analyzing high throughput genomics data (http://combattb.org). Among his software tools is the Baobab Laboratory Information Management System used by biobanks in Africa (http://baobablims.org). He serves on a number of international scientific advisory boards and also advisor to the Africa CDC.

Claudia Emerson

Claudia Emerson, Ph.D., is the Founding Director of the Institute on Ethics & Policy for Innovation, Professor in Department of Philosophy, Associate Member in the Department of Medicine, and Faculty Member in the Global Nexus, School for Pandemic Prevention and Response, at McMaster University, Canada.
Her work in applied ethics considers ethics issues and policy gaps in global health research, and she has been working with stakeholders in the field for nearly twenty years examining issues that arise along the discovery-to-delivery pathway for health technologies and interventions. She is especially interested in issues related to the introduction and adoption of emerging technologies, the management of infectious disease, and data ethics and governance. She is currently the Principal Investigator of research programs funded by the Bill & Melinda Gates Foundation, and the Canadian Institutes for Health Research, that consider these issues. Prof. Emerson serves in several advisory capacities related to public health and innovation, and has advised funders, government, industry, WHO and DARPA on ethics issues related to emerging pathogenic threats.

Barney S. Graham

Barney S. Graham, M.D., Ph.D., is an immunologist, virologist, and clinical trials physician who is a thought leader on structure-based vaccine design, application of mRNA delivery technology, and pandemic preparedness. He obtained an undergraduate degree from Rice University, a medical degree from the University of Kansas, and completed internal medicine residency, chief residencies, ID fellowship, and PhD in Microbiology and Immunology at Vanderbilt University. He joined the NIAID Vaccine Research Center at NIH as a founding member in 2000 and retired as Deputy Director of the VRC in 2021. He is now Director of the David Satcher Global Health Equity Institute and Professor of Medicine and Microbiology, Biochemistry, & Immunology at Morehouse School of Medicine in Atlanta. He is an inventor on vaccines and monoclonal antibodies approved for human use for the prevention or treatment of RSV, COVID-19, and Ebola. He is a member of the National Academy of Sciences, has received numerous awards for the advancement of science and vaccinology, and has been recognized by Time magazine as one of the world's 100 most influential individuals and one of the Heroes of the Year in 2021 and one of the 100 most influential in health in 2024.

Melissa Haendel

Melissa Haendel, Ph.D., is the Director of Precision Health & Translational Informatics and the Sarah Graham Kenan Distinguished Professor in the Department of Genetics at the University of North Carolina at Chapel Hill and co-founder of the Monarch Initiative and the National Covid Cohort Collaborative. Her background is molecular genetics and developmental biology as well as translational informatics, with a focus over the past decade on open science and semantic engineering. Dr. Haendel's vision is to weave together healthcare systems, basic science research, and patient generated data through development of data integration technologies and innovative data capture strategies. Dr. Haendel's research has focused on integration of genotype-phenotype data to improve rare disease diagnosis and mechanism discovery. She also leads and participates in international standards organizations to support improved data sharing and utility worldwide.

Yvan Hutin

Yvan J-F. Hutin, Ph.D. is the director of the Department of Surveillance, Prevention and Control [SPC] of the AMR Division of WHO headquarters. Following his MD and specialization in hepato-gastroenterology in France and an MSc in clinical tropical medicine at the London School of Tropical Medicine and Hygiene, he joined the Epidemic Intelligence Service of the US-CDC and completed a PhD at the Swiss Tropical Institute. He worked on public health in Burkina Faso, in Uganda and in Sweden at the European CDC. During more than twenty years at WHO at the three levels of the Organization, he initiated the Safe Injection Global Network (SIGN), assisted India in the setup of its Field Epidemiology Training Programme (FETP), worked on hepatitis B in China, coordinated strategic information at the Global Hepatitis Programme and was director of communicable diseases in the Regional Office for the Eastern Mediterranean Region. His areas of expertise include epidemiology, prevention, care and treatment of communicable diseases, public health training, economic analyses, and financing. Dr Hutin co-authored more than 140 publications in peer review journals.

Chikwe Ihekweazu

Chikwe Ihekweazu, D.Sc., is Assistant Director-General at the Health Emergencies Programme of the World Health Organization.

Prior to this, Dr Ihekweazu was the first Director General of the Nigeria Centre for Disease Control (NCDC) and led the agency between July 2016 and October 2021, where he built up this national public health agency from a small unit to a leading public health agency in Africa, working closely with the Africa Centres for Disease Control. He acted as Interim Director of the West Africa Regional Centre for Surveillance and Disease Control through 2017.

Dr Ihekweazu trained as an infectious disease epidemiologist and has worked in leadership positions in several national public health agencies, including NCDC, the South African National Institute for Communicable Diseases (NICD), the UK's Health Protection Agency (HPA), and Germany's Robert Koch

Institute (RKI). Dr Ihekweazu led several short-term engagements for WHO, mainly to build surveillance systems and in response to major infectious disease outbreaks around the world. He was part of the first WHO COVID-19 international mission to China, in February 2020.

Dr Ihekweazu is a graduate of the College of Medicine, University of Nigeria and has a Master in Public Health (MPH) from the Heinrich-Heine University, Dusseldorf, Germany. In 2003, he was awarded a Fellowship for the European Programme for Intervention Epidemiology Training (EPIET) and subsequently completed his Public Health specialisation in the UK (FFPH). He has over 150 publications in medical peer review journals mostly focused on the epidemiology of infectious diseases.

He is the recipient of an Honorary Doctor of Science (DSc) awarded by the Liverpool School of Tropical Medicine, UK, the National Productivity Order of Merit (NPOM) of the Order of the Niger (OON) awarded by the President of the Federal Republic of Nigeria, for his service to Nigeria.

Rob Knight

Rob Knight, Ph.D., is the founding Director of the Center for Microbiome Innovation and Professor of Pediatrics, Bioengineering, Computer Science & Engineering and Halıcıoğlu Data Science Institute at UC San Diego. He is the Wolfe Family Endowed Chair in Microbiome Research at Rady Children's. He received the Massry Prize in 2017. His lab has produced many of the software tools and laboratory techniques that enabled high-throughput microbiome science, including QIIME and UniFrac. His work has linked microbes to a range of health conditions, enhanced our understanding of microbes in many environments, and made high-throughput sequencing accessible to thousands of researchers around the world. He set up and runs the wastewater COVID-19 detection program at UC San Diego, which deploys over 140 robotic autosamplers and analyzes samples the same day by qPCR, and co-founded the EXCITE COVID-19 testing lab at UC San Diego, which performs thousands of clinical tests per day and also sequences viral genomes out of wastewater and clinical samples.

Courtney Lias

Courtney H. Lias, Ph.D., studied at the Johns Hopkins University School of Medicine where she received her Ph.D. in Biochemistry, Cellular, and Molecular Biology. Currently, Dr. Lias is the Acting Director of FDA’s Office of In Vitro Diagnostic Devices. During her FDA career of nearly two decades, she has led efforts to promote development of new therapeutic and diagnostic devices, including devices for diabetes and drug dosing and monitoring. In 2017, Dr. Lias received the Samuel J. Heyman Service to America Medal in Management Excellence. This honor was awarded for work promoting the efficient development and approval of the first automated insulin dosing system.

Ruth Lynfield

Ruth Lynfield, M.D., received her medical degree from Cornell University Medical College and did postgraduate training in pediatrics and in pediatric infectious diseases at Massachusetts General Hospital (MGH) and attended in pediatric infectious diseases at MGH from 1992-1997. Dr. Lynfield then joined the Minnesota Department of Health as a medical epidemiologist and was appointed State Epidemiologist in 2007 and Medical Director of the department in 2010. She is the Co-Principal Investigator of the Minnesota Emerging Infections Program, and of the Minnesota Pathogen Genomics Center of Excellence. She has conducted infectious disease investigations and responses to outbreaks, public health research, evaluation, and planning. She has served on multiple federal advisory committees and public health work groups. She is an Adjunct Professor of Medicine, and of Epidemiology and Community Health at the University of Minnesota.

Duncan MacCannell

Duncan MacCannell, Ph.D., is the former chief science officer and current Director of the Office of Advanced Molecular Detection (OAMD) at the U.S. Centers for Disease Control and Prevention (CDC). In this role, he leads strategic innovation and expansion of emerging technologies, including pathogen genomics, molecular epidemiology, and bioinformatics across the public health system. OAMD collaborates with all of CDC's infectious disease programs, and works closely with state and local health departments and a

growing number of global partners and institutions. Dr. MacCannell advocates for open, reproducible science, improved access to bioinformatic tools and training, and to the rapid and equitable exchange of public health and pathogen sequence information. With a background in public health microbiology and molecular epidemiology, he has contributed to the PulseNet program and has served as the laboratory surveillance lead for antimicrobial resistant and healthcare-associated pathogens. Dr. MacCannell holds a doctorate in microbiology and infectious diseases and a master's degree in biotechnology from the University of Calgary, and a bachelor's degree in biochemistry from McGill University in Montreal.

Bronwyn MacInnis

Bronwyn MacInnis, Ph.D., is director of pathogen genomic surveillance in the Infectious Disease and Microbiome Program at the Broad Institute of MIT and Harvard, where she is also an institute scientist. She also co-leads the Broad's multidisciplinary Global Health Initiative and is a visiting scientist at the Harvard T.H. Chan School of Public Health.

Her work focuses on understanding how pathogens of global importance evolve as they spread in time and space, and how this information can be translated into practical applications for public health. Her primary focus is on leveraging advances in genomics and data science to improve our ability to detect, track, and limit the spread of malaria parasites and viral threats including Ebola, Zika, and SARS-CoV-2. MacInnis also focuses on building local capacity to integrate these into public health practice, both domestically and in lower resource settings around the world. She co-led the Broad Institute's large scale COVID genomic surveillance program and now co-leads the CDC's Pathogen Genomics Center of Excellence for the Northeast, working closely with the Massachusetts Department of Public Health and the US Centers for Disease Control and Prevention. She also served as a technical advisor to the World Health Organization to develop use cases for genomic data in malaria surveillance and control, and data sharing guidelines for global pandemic preparedness strategy.

Prior to joining the Broad Institute, MacInnis was a senior scientific program manager at the Wellcome Sanger Institute in the UK, where she co-led the Malaria Genomic Epidemiology Network (MalariaGEN), a global data sharing community aimed at translating genome science into tools for malaria control and elimination. She completed her Ph.D. at the University of Alberta in Canada, and was a Human Frontiers in Science Program Postdoctoral Fellow at Stanford University.

Sharon Peacock

Sharon Peacock is Master Elect of Churchill College, Cambridge and Professor of Microbiology and Public Health at the University of Cambridge. She led the COVID-19 Genomics UK Consortium (COG-UK), formed in April 2020 to provide SARS-CoV-2 genomes during the pandemic. Prior to this, she spent a decade on the translation of pathogen sequencing into public health microbiology. Sharon is a Fellow of the Academy of Medical Sciences, Fellow of the American Academy of Microbiology, and an elected Member of the European Molecular Biology Organization (EMBO). She was awarded a CBE for services to Microbiology in 2015, and in 2021 received the Medical Research Council Millennium Medal.

Alexandra Phelan

Alexandra Phelan, SJD, LLM, LLB is an Associate Professor at Johns Hopkins Bloomberg School of Public Health, Senior Scholar at the Johns Hopkins Center for Health Security, and Faculty Director (Policy) at the Johns Hopkins Institute of Planetary Health. Dr Phelan is a global health lawyer, specializing in international law and infectious diseases, and the impact of global change events on health, including climate change and biodiversity loss. She/they advises international organizations and governments on pandemic prevention, preparedness and response, and has served on international and national advisory bodies, including for WHO and U.S. National Academies. Dr Phelan holds an SJD in international law and infectious diseases from Georgetown University Law Center, an LLM from the Australian National University, and a dual BBiomedSc/LLB from Monash University. They previously worked as a solicitor at a leading law firm in the Asia Pacific and admitted to practice as a barrister and solicitor of the Supreme Court of Victoria and High Court of Australia.

Lisa A. Purcell

Lisa Purcell has been an Entrepreneur-In-Residence at Third Rock Ventures since May of 2024. Her career has been dedicated to the development of therapies within the immunology and infectious disease areas. During the COVID-19 pandemic, she co-chaired the ACTIV partnership established by the NIH, bringing together government agencies, nonprofit organizations and biopharmaceutical companies to monitor the virus and evaluate new treatments and vaccines. Previous to Third Rock, she was the Senior Vice President and Head of Research and Translational Medicine at Vir Biotechnology where she led nonclinical and development teams for hepatitis B, hepatitis D, COVID-19, influenza, HIV, gram-positive bacteria and functional genomics approaches. She joined Regeneron Pharmaceuticals after completing her postdoctoral training at Columbia University Vagelos College of Physicians and Surgeons and led early- and late-stage development programs, including several trials for atopic dermatitis, asthma, eosinophilic esophagitis, therapeutic/prevention studies for COVID-19 and research programs in immunology and infectious diseases. She received her Ph.D. from McGill University. She currently serves on several Scientific Advisory Boards.

Pardis Sabeti

Pardis Sabeti, M.Sc., D.Phil, M.D., is a Professor at Harvard University, the Harvard T.H. Chan School of Public Health, the Broad Institute of Harvard and MIT, and a Howard Hughes Investigator. Her computational genomic lab has contributed to widely varying fields — including human and microbial genomics, information theory, and rural infectious disease surveillance and education efforts in West Africa. She completed a B.S. at MIT, M. Sc. and D.Phil at Oxford University, and M.D. summa cum laude from Harvard Medical School. Sabeti is a National Academy of Medicine member, World Economic Forum Young Global Leader, National Geographic Emerging Explorer, the National Academy of Sciences Richard Lounsbery Award, Smithsonian American Ingenuity Award winner for Natural Science, TIME magazine "Person of the Year" as one of the Ebola fighters, and TIME's 100 Most Influential. She is the host of 'Against All Odds' included as part of AP stats classes nationwide, and is the lead singer of the rock band Thousand Days.

Stephen Sherry

Stephen Sherry, Ph.D., is the Acting Director of the National Library of Medicine (NLM) at the National Institutes of Health (NIH). NLM is a leader in biomedical informatics and computational health data science research and the world's largest biomedical library.

Dr. Sherry brings a history of innovation and leadership to NLM. Prior to serving as Acting Director in October 2023, Dr. Sherry served as Director of NLM's National Center for Biotechnology Information (NCBI) and NLM Associate Director for Scientific Data Resources. Under his leadership, NLM developed advanced computational solutions for life and health science information needs and facilitated open science and scholarship through a growing array of data, literature, and other information offerings and services made available by NLM.

Dr. Sherry's vision to advance NLM's mission includes enhancing health and research through robust, sustainable information resources and transformative information science, engineering, and technology development, all while leading in engineering excellence for resilience, reliability, and representation in the era of artificial intelligence. He is recognized for his inventiveness in leveraging research assets to support public health emergency response. Dr. Sherry has been central in key innovations at NLM including the ClinicalTrials.gov Modernization effort and development of the NIH Comparative Genomics Resource, ensuring public input and technical innovation in the process. Dr. Sherry positioned NCBI as a strong collaborative force across the NIH and in support of major NLM projects including the NIH Preprint Pilot for rapid access to NIH-funded research and the MEDLINE 2022 initiative, which resulted in 100% automated indexing of the biomedical literature available through NLM's PubMed and PubMed Central (PMC).

Throughout his tenure at NLM, Dr. Sherry has participated in many NIH efforts to characterize human genetic diversity and has served on numerous working groups across NIH to address a range of data

science issues including the development of the genomic data sharing policy, privacy analysis for risk-sensitive data sets and advances in scientific publications.

Dr. Sherry earned his Ph.D. in Anthropology at Pennsylvania State University in 1996 and completed a postdoctoral fellowship at the Louisiana State University Medical Center prior to joining NLM in 1998.

Richard Wilder

Richard Wilder is a professor of practice at the University of New Hampshire Franklin Pierce School of Law, and a senior scholar at the O'Neill Institute for National and Global Health Law. Most recently, he served as general counsel and director of legal and business development at the Coalition for Epidemic Preparedness Innovations. There, he directed the legal and business development affairs of CEPI during its initial start-up phase and through the first two years of the response to the COVID-19 pandemic. He previously had a similar role in the global health program at the Bill & Melinda Gates Foundation. Prior to that, he led the intellectual property policy team at the Microsoft Corporation where he was responsible for defining and driving the company-wide policy in all areas of intellectual property. Wilder has spent years as a partner in a global law firm, where he specialized in international trade law and practiced in the field of global public health.

Mike Worobey

Michael Worobey, D. Phil., taps into the genomes of viruses, using molecular and computational biology, to understand the origins, emergence and control of pandemics. He has made discoveries pinpointing, for example, where, when and how HIV originated and spread worldwide and how influenza pandemics, including the intense 1918 pandemic, emerge and kill large numbers of people. Recently, his interdisciplinary work on SARS-CoV-2 has shed light on how and when the virus originated and ignited the COVID-19 pandemic in China and how SARS-CoV-2 emerged and took hold in North America and Europe.

Current research includes (1) SARS-CoV-2 genomic epidemiology and evolution from local to global scales, (2) work at the intersection of viral evolution and immunology with both SARS-CoV-2 and influenza viruses, (3) influenza vaccines, and (4) pandemic preparedness and prevention.

Preventing Discrimination, Harassment, and Bullying Expectations for Participants in NASEM Activities

The National Academies of Sciences, Engineering, and Medicine (NASEM) are committed to the principles of diversity, integrity, civility, and respect in all of our activities. We look to you to be a partner in this commitment by helping us to maintain a professional and cordial environment. All forms of discrimination, harassment, and bullying are prohibited in any NASEM activity. This commitment applies to all participants in all settings and locations in which NASEM work and activities are conducted, including committee meetings, workshops, conferences, and other work and social functions where employees, volunteers, sponsors, vendors, or guests are present.

Discrimination is prejudicial treatment of individuals or groups of people based on their race, ethnicity, color, national origin, sex, sexual orientation, gender identity, age, religion, disability, veteran status, or any other characteristic protected by applicable laws.

Sexual harassment is unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature that creates an intimidating, hostile, or offensive environment.

Other types of harassment include any verbal or physical conduct directed at individuals or groups of people because of their race, ethnicity, color, national origin, sex, sexual orientation, gender identity, age, religion, disability, veteran status, or any other characteristic protected by applicable laws, that creates an intimidating, hostile, or offensive environment.

Bullying is unwelcome, aggressive behavior involving the use of influence, threat, intimidation, or coercion to dominate others in the professional environment.

Section 1.01 REPORTING AND RESOLUTION

Any violation of this policy should be reported. If you experience or witness discrimination, harassment, or bullying, you are encouraged to make your unease or disapproval known to the individual, if you are comfortable doing so. You are also urged to report any incident by:

- Filing a complaint with the Office of Human Resources at 202-334-3400, or
- Reporting the incident to an employee involved in the activity in which the member or volunteer is participating, who will then file a complaint with the Office of Human Resources.

Complaints should be filed as soon as possible after an incident. To ensure the prompt and thorough investigation of the complaint, the complainant should provide as much information as is possible, such as names, dates, locations, and steps taken. The Office of Human Resources will investigate the alleged violation in consultation with the Office of the General Counsel.

If an investigation results in a finding that an individual has committed a violation, NASEM will take the actions necessary to protect those involved in its activities from any future discrimination, harassment, or bullying, including in appropriate circumstances the removal of an individual from current NASEM activities and a ban on participation in future activities.

Section 1.02 CONFIDENTIALITY

Information contained in a complaint is kept confidential, and information is revealed only on a need-to-know basis. NASEM will not retaliate or tolerate retaliation against anyone who makes a good faith report of discrimination, harassment, or bullying.

Diversity, Equity, and Inclusion Statement and Guiding Principles

We, the National Academies of Sciences, Engineering, and Medicine (the National Academies), value diversity among our staff, members, volunteers, partners, vendors, and audiences. We recognize that talent is broadly distributed in society and that many perspectives enhance the quality of our work and drive innovation and impact.

We pledge to cultivate a workplace culture and climate that promotes inclusion, belonging, accessibility, and anti-racism; upholds equity; and values the participation of all who are engaged in advancing our mission.[1] By embracing the values of diversity, equity, and inclusion in our programs, institutional policies and practices, and products, we will be able to better advise the nation on the most complex issues facing society and the world.

Guiding Principles:

The following diversity, equity, and inclusion principles guide our work at the National Academies:

1. Integrate diverse perspectives and experiences into our programs, institutional policies and practices, and products.

2. Foster a culture of inclusion where all staff, members, and volunteers have full access to participation and feel welcomed, respected, valued, and a sense of belonging.

3. Approach scientific endeavors with a consideration of diversity, equity, and inclusion frameworks.

4. Cultivate mutually beneficial diverse partnerships and collaborations with a variety of communities, including, but not limited to, marginalized and underrepresented communities.

Our institutional strategy for putting these values and principles into practice are outlined in the National Academies DEI Action Plan, a comprehensive five-year plan that charts a path toward achieving our diversity, equity, and inclusion goals. The DEI Action Plan is one of many ways that we commit to systems of accountability and transparency to uphold these principles and allow for continuous learning and improvement.

Updated June 7, 2018