NATIONAL ACADEMIES Sciences Engineering Medicine

Mitigating Arboviral Threats and Strengthening Public Health Preparedness

A Workshop

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

Workshop Briefing Book
December 12-13, 2023

Contents

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.

Sponsors

- U.S. Agency for International Development
- U.S. Centers for Disease Control and Prevention
- U.S. Department of Veterans Affairs
- U.S. National Institute of Allergy and Infectious Diseases
- Uniformed Services University of the Health Sciences
- Burroughs Wellcome Fund
- American Society of Tropical Medicine and Hygiene
- EcoHealth Alliance
- Infectious Diseases Society of America
- Johnson & Johnson
- Merck & Co., Inc.
- New Venture Fund
- Rockefeller Foundation
- Sanofi Pasteur
- Society of Infectious Diseases Pharmacists

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

Highlights of Recent Publications

- 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)
- Exploring Lessons Learned from a Century of Outbreaks: Readiness for 2030: Proceedings of a Workshop (2019)
- Understanding the Economics of Microbial Threats: Proceedings of a Workshop (2018)
- Urbanization and Slums: Infectious Diseases in the Built Environment: Proceedings of a Workshop (2018)

Forum's Action Collaborative – One Health

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.

Upcoming Events from the Forum

ASSESSING THE BURDEN OF ANTIMICROBIAL RESISTANCE: A WORKSHOP ON POTENTIAL POLICY OPTIONS TO SUPPORT SCIENTIFIC INNOVATION

There is broad recognition of the critical need to address the development and spread of antimicrobial resistance (AMR). A global, systematic analysis estimates that AMR infections lead to 1.27-4.95 million deaths per year, and resistant bacterial infections are now a leading cause of neonatal mortality worldwide. While scientific and economic challenges have long hindered development of novel antimicrobials, recent pull incentives have been proposed to support a sustainable market and investment in new antimicrobials. These recent discussions provide a timely opportunity to explore the current burden of AMR and discuss potential future policies in the context of new scientific innovations.

A planning committee of the National Academies of Sciences, Engineering, and Medicine will organize a public workshop to explore the current burden of antimicrobial resistance and discuss opportunities for future policies in the context of new scientific innovations and potential disruptions from proposed and pilot incentive mechanisms. To receive a "Save the Date" announcement for our events, sign up for our listserv here: www.nationalacademies.org/microbialthreats

Forum on Microbial Threats Members

Peter Daszak, Ph.D. ***(chair)***
EcoHealth Alliance

Cristina Cassetti, Ph.D. ***(vice chair)***
National Institute of Allergy and Infectious Diseases

Kent E. Kester, M.D. ***(vice chair)***
International AIDS Vaccine Initiative

Emily Abraham, Dr.P.H.
Johnson & Johnson

Kevin Anderson, Ph.D.
Retired

Daniel Barouch, M.D., Ph.D.
Harvard Medical School

Daniel Bausch, M.D., M.P.H.
American Society of Tropical Medicine and Hygiene

Nahid Bhadelia, M.D., M.A.L.D.
Boston University School of Medicine

Christopher Braden, M.D.
U.S. Centers for Disease Control and Prevention

Rick Bright, Ph.D.
Bright Global Health

Ambika Bumb, Ph.D.
Bipartisan Commission on Biodefense

Andrew Clements, Ph.D.
U.S. Agency for International Development

Scott F. Dowell, M.D., M.P.H.
Bill and Melinda Gates Foundation

Timothy Endy, M.D., M.P.H.
Coalition for Epidemic Preparedness

Marcos A. Espinal, M.D., Dr.P.H., M.P.H.
Pan American Health Organization

Greg Frank, Ph.D.
Merck & Co., Inc.

Wondwossen Gebreyes, D.V.M.
The Ohio State University

Bruce Gellin, M.D., M.P.H.
The Rockefeller Foundation

Gigi Gronvall, Ph.D.
Johns Hopkins Bloomberg School of Public Health

Eva Harris, Ph.D.
University of California, Berkeley

Jon H. Heinrichs, Ph.D., M.S.
Sanofi Pasteur

Elizabeth D. Hermsen, Pharm.D., M.B.A.
Pfizer, Inc.

Albert I. Ko, M.D.
Yale School of Public Health
Yale School of Medicine
Gonçalo Moniz Institute, Oswaldo Cruz Foundation, Ministry of Health, Salvador, Brazil

Mark G. Kortepeter, M.D., M.P.H.
Uniformed Services University of Health Sciences

Linda Lloyd, Dr.P.H., M.P.H.
San Diego State University School of Public Health

Syra Madad, D.H.Sc., M.S., M.C.P.
NYC Health + Hospitals

Victoria McGovern, Ph.D.
Burroughs Wellcome Fund

Sumiko Mekaru, D.V.M., Ph.D.
The Public Health Company

Timothy D. Murray, Ph.D.
Washington State University

Melissa Nolan, Ph.D., M.P.H.
University of South Carolina

Rafael Obregon, Ph.D., M.A.
United Nations Children's Fund

Benjamin Pinsky, M.D., Ph.D.
Stanford University

Ameet J. Pinto, Ph.D., M.S.
Georgia Institute of Technology

P. David Rogers, Pharm. D., Ph.D., FCCP
St. Jude Children's Research Hospital

Gary A. Roselle, M.D.
U.S. Department of Veterans Affairs

Peter A. Sands, M.P.A.
The Global Fund to Fight AIDS, Tuberculosis & Malaria

Umair Shah, M.D., M.P.H.
Washington State Department of Health

Jonathan Sleeman, M.A., VetMB, Dipl. ACZM
U.S. Geological Survey

Matthew Zahn, M.D.
Orange County Health Care Agency
(California)

Forum on Microbial Threats Staff

Julie Liao, Ph.D.
Director, Forum on Microbial Threats
(202) 334-2191
JLiao@nas.edu

Liz Ashby, M.Sc.
Program Officer
(202) 334-2248
EAshby@nas.edu

Claire Biffl
Research Associate
(202) 334-2178
CBiffl@nas.edu

Mitigating Arboviral Threats and Strengthening Public Health Preparedness

A Workshop

December 12-13, 2023 | Washington, DC

PURPOSE

A planning committee of the National Academies of Sciences, Engineering, and Medicine will organize a public workshop to explore the role of arbovirus mitigation within the context of public health preparedness and capacity building. Workshop discussions will consider potential actions that can be taken to understand and mitigate arboviral disease threats and highlight priority areas for research and investment through examining:

1. Lessons learned from Zika and chikungunya epidemics, including shared learnings from COVID-19 and mpox;
2. Aspects of public health preparedness, such as environmental and urban planning issues, that will mutually benefit from enhanced arbovirus mitigation;
3. Current efforts and approaches for determining high-risk pathogens and vectors;
4. Current capacity for detecting, diagnosing, and scaling up testing for exotic arboviruses (including surveillance systems and diagnostic laboratory capacity);
5. The status of vaccine development and availability for arboviruses, including highlights of promising technologies for advancement;
6. Development and use of vector-targeted mitigation and elimination strategies, including the current status and potential impact of innovative technologies; and
7. Strategies for strengthening and supporting the necessary workforce in research, development, and public health to address arboviral threats.

The planning committee will organize the workshop, develop the agenda, select speakers and discussants, and moderate or identify moderators for the discussions. A proceedings publication that summarizes the presentations and discussions held during this workshop will be prepared by a designated rapporteur in accordance with institutional guidelines.

Workshop Agenda

December 12-13, 2023
9:00 AM – 5:00 PM ET (December 12)
9:00 AM – 3:15 PM ET (December 13)
Virtual webcast *or* in person at the National Academy of Sciences Building | 2101 Constitution Ave. NW, Washington D.C. | Lecture Hall

Day 1: Current Landscape and Risk Assessment of Arboviral Threats	
9:00 – 9:15 am	**Welcome remarks, workshop overview, and goals** **Welcome** Peter Daszak, EcoHealth Alliance *Workshop co-chair* *Chair, Forum on Microbial Threats* **Introduction and workshop overview** Thomas W. Scott, University of California, Davis *Workshop co-chair*
9:15 – 9:45 am	**Advancing global arbovirus research priorities** Eve Lackritz, CIDRAP
9:45 – 11:15 am	**Session 1: Current and Emerging Threats from Arboviral Disease – Burden and Future Risk** **Moderator:** Marcos Espinal, PAHO **The threat of arbovirus diseases: current status and mitigation efforts** Duane Gubler, Duke National University of Singapore **Country and regional experience: impacts and challenges of arbovirus control** Sylvain Aldighieri, PAHO **Challenge of prevention and control of arboviruses in the US** Laura Kramer, State University of New York at Albany Raman Velayudhan, WHO

	Q&A
11:15 – 11:30 am	**BREAK**
11:30 am – 1:00 pm	**Session 2: Assessing and Detecting Arboviral Risk** **Moderator:** Eva Harris, University of California, Berkeley *Surveillance* **Epidemiological surveillance** Diana Rojas, WHO **Genomic surveillance** Nuno Faria, Imperial College London **Integrated surveillance and risk assessment: case study from Singapore** Lee-Ching Ng, Environmental Health Institute Singapore *Diagnostics* **Diagnostics for arbovirus mitigation** Rosanna Peeling, London School of Hygiene and Tropical Medicine **Q&A**
1:00 – 2:00 pm	**LUNCH**
2:00 – 3:30 pm	**Session 3: Response to Arboviral Threats** **Moderator:** Ann Powers, CDC **Arbovirus vaccines: dengue case study** Gabriela Paz-Bailey, CDC **Vector control** Thomas W. Scott, University of California, Davis **Integrated surveillance in the Americas** Thais dos Santos, PAHO **Predictive tools and modeling** Oliver Brady, London School of Hygiene and Tropical Medicine

	Q&A
3:30 – 3:45 pm	**BREAK**
3:45 – 4:45 pm	**Session 4: Lessons Learned from Previous Outbreaks** **Moderator:** Kent Kester, IAVI **Previous arbovirus outbreaks** Erin Staples, CDC **COVID-19** Peter Hotez, Baylor College of Medicine **Q&A**
4:45 – 5:00 pm	**Synthesis and adjourn** Peter Daszak, EcoHealth Alliance
END OF DAY 1	

Day 2: Innovation for Future Arbovirus Mitigation	
9:00 – 9:15 am	**Welcome remarks, review of day 1** Peter Daszak, EcoHealth Alliance

9:15 – 10:45 am	**Session 5: Arbovirus Spillover and Spread** **Moderator:** Peter Daszak, EcoHealth Alliance **Spillover and emergence of zoonotic pathogens** Jamie Lloyd-Smith, University of California, Los Angeles **Implementation science: operationalizing One Health data** Nikos Vasilakis, University of Texas Medical Branch **Arbovirus risk assessment** Segaran Pillai, Food and Drug Administration **Behavior change to prevent arboviral disease** Valerie Paz-Soldán, Tulane University **Q&A**
10:45 – 11:00 am	**BREAK**
11:00 am – 12:30 pm	**Session 6: Urban Development and Management** **Moderator:** Linda Lloyd, San Diego State University **Building out Aedes: eliminating dengue as an urban threat** Steven Lindsay, Durham University **Public health in urban environments** Graham Alabaster, UN Habitat **Case study from Singapore** Eng Eong Ooi, Duke National University of Singapore **Urban mosquito control in Africa and the new mosquito on the block** Anne Wilson, Liverpool School of Tropical Medicine **Q&A**
12:30 – 1:30 pm	**LUNCH**

1:30 – 3:00 pm	**Session 7: Strengthening Preparedness for Arboviral Diseases** **Moderator:** Albert Ko, Yale University **Panel Discussion: innovative and sustainable solutions for arbovirus mitigation** Lee Ching Ng, Environmental Health Institute of Singapore Linda Lloyd, San Diego State University Audrey Lenhart, CDC Kariuki Njenga, Washington State University **Q&A**
3:00 – 3:15 pm	**Synthesis and close** Thomas W. Scott, University of California- Davis
END OF WORKSHOP	

Workshop Planning Committee

Thomas W. Scott, Ph.D. *(Co-Chair)* [1]
Distinguished Professor
University of California, Davis

Peter Daszak, Ph.D. *(Co-Chair)* [1,2]
President
EcoHealth Alliance

Kevin Anderson, Ph.D. [1*]
Department of Homeland Security (retired)

Marcos Espinal, M.D., Dr.P.H., M.P.H. [1,*]
Assistant Director
Pan American Health Organization

Eva Harris, Ph.D.[*]
Professor
University of California, Berkeley

Kent E. Kester, M.D. [1,3,*]
Vice President
Translational Medicine
IAVI

Albert I. Ko, M.D. [1*]
Raj and Indra Nooyi Professor of Public Health
Yale School of Public Health

Linda S. Lloyd, Dr.P.H., M.P.H.[1,*]
Independent Consultant
Lecturer
San Diego State University

Valerie Paz-Soldán, Ph.D., M.P.H.
Associate Professor
Tulane School of Public Health and Tropical Medicine

Benjamin Pinsky, M.D., Ph.D.[1,*]
Professor
Stanford University School of Medicine

Ann M. Powers, Ph.D.
Associate Director for Science
Centers for Disease Control and Prevention

---

* Member, National Academy of Medicine
[1] Member, Forum on Microbial Threats
[2] Chair, Forum on Microbial Threats
[3] Vice chair, Forum on Microbial Threats

Planning Committee Biographies

Thomas W. Scott, Ph.D., (co-chair), is a Distinguished Professor of mosquito transmitted disease ecology and epidemiology at the University of California, Davis. He received his Ph.D. in ecology from the Pennsylvania State University and was a post-doctoral fellow in epidemiology at the Yale School of Medicine. After initially examining the relationship of mosquito ecology to pathogen transmission in Southeast Asia, Latin America, and Africa in the early 1990s, in an effort to strengthen the public health connection of his work, he began longitudinal epidemiological studies in Thailand and Peru that lasted for more than twenty-five years. He currently focuses on assessing recommendations for mosquito-borne disease prevention, testing assumptions in public health policy, and developing innovative, cost, and operationally effective concepts for disease prevention. At UC Davis he was Director of the Center for Vector-Borne Disease Research and the Davis Arbovirus Research Unit. He chaired the Mosquito-Borne Disease Working Group in the Research and Policy in Infectious Disease Dynamics (RAPIDD) program, which developed novel mathematical modeling frameworks and reported to the Science and Technology Directorate, Department of Homeland Security, and Fogarty International Center at NIH. At the World Health Organization he chaired the Vector Control Advisory Group, co-chaired the Global Vector Control Response, chaired the Emergency Response Consultation for Zika Virus, chaired the Technical Working Group for Dengue, serves on the Technical Advisory Group for the Global Arbovirus Initiative, and serves on the International Health Regulators Roster of Experts. He is a member of the Management Committee for the Global Dengue and Aedes-Transmitted Diseases Consortium and is a member of the Executive Committee for the Lancet Commission on Aedes-transmitted Diseases.

Peter Daszak, Ph.D., (co-chair), is president of EcoHealth Alliance, a U.S.-based organization that conducts research and outreach programs on global health, conservation, and international development. Dr. Daszak's research has been instrumental in identifying and predicting the impact of emerging diseases across the globe. His achievements include identifying the bat origin of SARS, identifying the underlying drivers of Nipah and Hendra virus emergence, producing the first ever global emerging disease 'hotspots' map, developing a strategy to find out how many unknown viruses exist that could threaten to become pandemic, identifying the first case of a species extinction due to disease, and discovering the disease chytridiomycosis as the cause global amphibian declines. Dr. Daszak is a member and chair-elect of the National Academy of Sciences, Engineering and Medicine's Forum on Microbial Threats. He is a member of the National Research Council (NRC) Advisory Committee to the U.S. Global Change Research Program, the Supervisory Board of the One Health Platform, the One Health Commission Council of Advisors, the Center of Excellence for Emerging and Zoonotic Animal Diseases External Advisory Board, the Cosmos Club, and the Advisory Council of the Bridge Collaborative; he has served on the Institute of Medicine committee on global surveillance for emerging zoonoses, the NRC committee on the future of veterinary research, the International Standing Advisory Board of the Australian Biosecurity Cooperative Research Centres, and has advised the Director for Medical Preparedness Policy on the White House National Security Staff on global health issues. Dr. Daszak is a regular advisor to the World Health Organization (WHO), World Organisation for Animal Heatlh, and the Food and Agriculture Organization of the United Nations, and is actively involved in the WHO Expert group on Public Health Emergency Disease Prioritization. Dr. Daszak won the 2000 Commonwealth Scientific and Industrial Research Organisation medal for collaborative research on the discovery of amphibian chytridiomycosis, is the EHA institutional lead for USAID-EPT-PREDICT, is on the editorial boards of Conservation Biology, One Health, and Transactions of the Royal Society of Tropical Medicine & Hygiene, and is editor-in-chief of the journal EcoHealth. He has authored over 300 scientific papers, and his work has been the focus of extensive media coverage, ranging from popular press articles to television appearances.

Kevin Anderson, Ph.D. is a currently a free lance scientific consultant, who worked as a senior program manager in the Department of Homeland Security's (DHS's) Science and Technology Directorate and provided oversight and requirements for biodetection and biodiagnostics systems development for government-wide customers and stakeholders in support of national biodefense preparedness and response efforts. During his service to DHS, he provided leadership for science program development, laboratory design, and strategic planning; served as a subject matter expert and advisor to Bioterrorism Risk Assessments and Biological Threat Characterization programs; and participated in interagency working groups and assessments which provide guidance to medical countermeasure development, biological safety and biosecurity, which are key components of the nation's biodefense strategy. Prior to joining DHS, Dr. Anderson was a principal investigator at the U.S. Army Medical Research Institute of Infectious Diseases, leading research focused on understanding basic mechanisms of viral diseases causing hemorrhagic fever and development of medical countermeasures. He received postdoctoral training in molecular virology at the University of Alabama at Birmingham and the University of North Carolina at Chapel Hill, performing basic research on human respiratory syncytial viruses, and earned Ph.D. and B.S. degrees in microbiology from Montana State University and the University of Maryland, College Park, respectively.

Marcos A. Espinal, Ph.D., has over 30 years of experience in global health. He recently retired from the Pan American Health Organization where he held the positions of Assistant Director and Director of the Department of Communicable Diseases and Environmental Determinants of Health. Dr Espinal previous experience before PAHO included positions in the Ministry of Health of the Dominican Republic and the National Center for Research on Maternal and Child Health; the New York City Public Health Department; and the World Health Organization where he served as Executive Director of the Global Partnership to Stop TB, manager of the IUATLD/WHO Global Project on Drug Resistance Surveillance for Tuberculosis, and the DOTS-Plus Initiative for MDR-TB. Dr. Espinal has published more than 200 peer-reviewed scientific publications in the field of communicable diseases and authored numerous book chapters. He is a recipient of many prestigious awards including the Scientific Prize of the International Union against Tuberculosis and Lung Diseases, the Walter and Elise A. Hass International Award by the University of California at Berkeley for a distinguished record of service in international health, and the Princess Chichibu Memorial Tuberculosis Global Award by the Japan Anti-Tuberculosis Association. In 2018 Dr Espinal was honored by the UC Berkeley School of Public Health as one of the seventy-five most influential public health alumni over the entire 75-year history of the School of Public Health. He is a member of the Forum on Microbial Threats of the United States National Academies of Sciences, Engineering, and Medicine. Dr Espinal attended medical school at the Autonomous University of Santo Domingo. He holds a masters and doctor's degree in Public Health from the University of California at Berkeley.

Eva Harris, Ph.D., is Professor and Chair of the Division of Infectious Diseases and Vaccinology in the School of Public Health, Professor in the Division of Immunology and Molecular Medicine in the Department of Molecular and Cell Biology, Director of the Center for Global Public Health, and Chair of the Infectious Diseases and Immunity Graduate Group at the University of California, Berkeley. She has developed a multidisciplinary approach to study the molecular virology, pathogenesis, immunology, epidemiology, diagnostics, clinical aspects and control of dengue, Zika and chikungunya, the most prevalent mosquito-borne viral diseases in humans. Her work addresses immune correlates of protection and pathogenesis and viral and host factors that modulate disease severity, using in vitro approaches, animal models, and research involving human populations. One research major focus is on studies of arboviral disease in humans, including antibody and B cell responses and correlates of protection, diagnostics and seroprevalence studies, and viral evolution. Another focus is viral pathogenesis, specifically the role of flavivirus NS1 protein and other viral "toxins" in vascular leak and viral dissemination. Her international work includes laboratory-based and epidemiological studies of arboviral diseases in endemic Latin American countries, particularly in Nicaragua through close collaborations for over 35 years. Ongoing long-term projects in Nicaragua

include long-term clinical and biological studies of severe arboviral disease, as well as a 20-year pediatric cohort study of dengue and Zika in Managua. Dr. Harris has published over 355 peer-reviewed articles, as well as a book on her international scientific work. She is deeply committed to scientific capacity building globally; in 1997, she received a MacArthur Award for work over the previous ten years developing programs to build scientific capacity in developing countries to address public health and infectious disease issues. This enabled her to found a non-profit organization in 1998, Sustainable Sciences Institute (SSI; www.sustainablesciences.org), with offices in California and Nicaragua, to continue and expand this work worldwide. Dr. Harris was named a Pew Scholar for her work on dengue pathogenesis. She also received a national recognition award from the Minister of Health of Nicaragua for her contribution to scientific development and was selected as a "Global Leader for Tomorrow" by the World Economic Forum. In 2012, she was elected Councilor and in 2018 was appointed a Fellow of the American Society of Tropical Medicine and Hygiene. In 2019, she received the Beijerinck Virology Prize from the Royal Netherlands Society of Arts and Sciences. She currently serves on the Scientific Council of the Institut Pasteur, the Advisory Board of the Pew Latin American Fellows Program, and the Lancet Commission on Aedes-borne viral diseases.

Kent E. Kester, M.D., is currently Vice President, Translational Medicine, at IAVI. During a 24-year career in the US Army, he worked extensively in clinical vaccine development and led multiple research platforms at the Walter Reed Army Institute of Research, the U.S. Department of Defense's largest and most diverse biomedical research laboratory with a major emphasis on emerging infectious diseases, an institution he later led as its Commander. His final military assignment was as the Associate Dean for Clinical Research in the School of Medicine at the Uniformed Services University of the Health Sciences (USUHS). During his military service, Dr. Kester was appointed as the lead policy advisor to the US Army Surgeon General in both Infectious Diseases and in Medical Research & Development. More recently, he served as the head of translational medicine and biomarkers at Sanofi Pasteur. Dr. Kester holds an undergraduate degree from Bucknell University and an M.D. from Jefferson Medical College, completing his internship and residency in internal medicine at the University of Maryland and a research fellowship in infectious diseases at the Walter Reed Army Medical Center. Currently a member of the Department of Veterans Affairs Health Services Research & Development Service Merit Review Board, the National Academy Standing Committee on Emerging Infectious Diseases and 21st Century Health Threats, and the CEPI Scientific Advisory Committee, he previously chaired the Steering Committee of the NIAID/USUHS Infectious Disease Clinical Research Program, and has served as a member of the Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria (PACCARB), the FDA Vaccines & Related Biologics Products Advisory Committee (VRBPAC), the NIAID Advisory Council, and the CDC Office of Infectious Diseases Board of Scientific Counselors. He is the Vice Chair of the National Academy of Medicine Forum on Microbial Threats. Board-certified in both internal medicine and infectious diseases, Dr. Kester holds faculty appointments at USUHS and the University of Maryland; and is a fellow of the American College of Physicians, the Royal College of Physicians of Edinburgh, the Infectious Disease Society of America, and the American Society of Tropical Medicine and Hygiene.

Albert Icksang Ko, M.D., is the Raj and Indra Nooyi Professor of Public Health at the Yale School of Public Health and Collaborating Researcher at the Oswaldo Cruz Foundation, Brazilian Ministry of Health. He served as Chair of the Department of Epidemiology of Microbial Diseases at Yale (2010-2021) after being stationed with the Brazilian Ministry of Health in Salvador, Brazil for 15 years. His research centers on the health problems that have emerged as a consequence of rapid urbanization and social inequity. Dr. Ko coordinates an urban health program in Brazil, which focuses on delineating the role of social marginalization, urban ecology, and climate of infectious disease threats to informal settlements and implementing community-driven interventions in these settings. He and his team have mobilized the research and public health response to multiple epidemics, which include meningitis, leptospirosis, dengue, Zika virus infection and associated birth defects, and the COVID-19 pandemic. Dr. Ko is

Program Director of the Fogarty/NIH Global Health Equity Scholars Program which has trained more than 200 fellows in 21 low- and middle-income countries since 2012. He is a member of the WHO R&D Blueprint Working Group and Taskforce for Zika Virus and the NASEM Forum of Microbial Threats. During the pandemic, he was the co-chair of Reopen Connecticut Advisory Group which developed the state's COVID-19 response plan and served as advisor to Governor Lamont, in addition to providing support to the Oswaldo Cruz Foundation for its pandemic response in Brazil.

Linda Lloyd, Dr.PH, M.P.H, is a social scientist specializing in the design and evaluation of behavioural and community-centered health programs that reflect local socio-ecological contexts. She has worked with PAHO and WHO for over twenty-five years to strengthen ministry of health capacity in behavior change and risk communication for the prevention and control of vector-borne diseases through technical assistance, workshops, and training courses. Dr. Lloyd is a member of the Lancet Commission on Aedes-transmitted Viral Diseases (2019 to date) and the PAHO/WHO External Evaluation Group of New Technologies for Aedes spp. Control (2017 to date). She served on the PAHO/WHO Regional Lymphatic Filariasis Elimination Program Review Group (2008 to 2015), WHO-TDR Research Reference Group on Dengue and Other Viral Diseases of Major Public Health Importance (2009 to 2011), and the TDR/WHO Scientific Working Group on Dengue (2001, 2006). Dr. Lloyd is Adjunct Faculty at SDSU School of Public Health. She taught Global Health (PH780) from 2015 to 2020 and continues as a guest lecturer. She was the Director of the Center for Research at San Diego Hospice, where she was responsible for oversight of psychosocial research and clinical trials to improve patient care.

Valerie A. Paz-Soldan, PhD, MPH, is Associate Professor in the Tropical Medicine and Infectious Disease Department at the Tulane University School of Public Health and Tropical Medicine, and Director of Tulane's Health Office for Latin America (HOLA) in Lima, Peru, where she has been based permanently since 2004. She is a Peruvian-American social scientist who works with interdisciplinary teams applying both qualitative and quantitative research methods to improve knowledge of: 1) human behaviors (at the individual and organizational levels) associated to vector borne disease transmission, prevention and control, especially dengue, and 2) implementation science approaches applied to health care systems and policy in Peru. Her current work applies implementation science and systems thinking approaches to understand health problems, develop locally appropriate interventions, and translate evidence into practice, working primarily in the Amazon rainforest city of Iquitos, Peru.

Benjamin Pinsky, M.D., Ph.D., is Professor of Pathology and Medicine, in the Division of Infectious Diseases and Geographic Medicine at the Stanford University School of Medicine. He also has a courtesy appointment in the Stanford Department of Pediatrics, Division of Infectious Diseases. Dr. Pinsky earned his M.D. and Ph.D. degrees in the Medical Scientist Training Program at the University of Washington School of Medicine in Seattle and completed residency training in Clinical Pathology at the Stanford University School of Medicine. He serves as the U.S. editor-in-chief for the Journal of Clinical Virology and received the 2022 Diagnostic Virology Career Achievement Award from the Pan American Society for Clinical Virology.

Ann Powers, Ph.D., FASTMH, received her Ph.D. and postdoctoral training in Molecular Arbovirology focusing on molecular determinants of mosquito infectivity and alphaviral evolution. She served as an Assistant Professor at UTMB prior to joining the CDC in 2000. Currently, she is Associate Director for Science in the Division of Vector Borne Diseases and previously served as the Virology Team Lead in the Arboviral Diseases Branch. She has held numerous additional international and national positions including serving as Chair of the Togaviridae Study Group for the International Committee on Taxonomy of Viruses, Chairman of the American Committee on Arthropod-borne Viruses, Deputy Editor for the PLoS Neglected Tropical Diseases journal, Associate Editor for Emerging Infectious Diseases Journal, and as Councilor for the American Society for Tropical Medicine and Hygiene. She is the editor

of the International Catalog of Arboviruses which is a repository of data on the prototype strain of all registered arboviruses. She has authored over 170 scientific publications, book chapters, and public health documents on mosquito-borne viruses.

Speaker Biographies

Graham Alabaster, Ph.D., is a public health engineer by profession and is UN-Habitat's Director of the Geneva office, where he represents the Executive Director of UN-Habitat. He is responsible for liaison with Geneva-based member states missions and international organisations. He holds a BSc (Hons.) in Chemical Engineering and a PhD in Civil Engineering. After an early career in academic research in the UK and Africa, and a period in industry, he joined UN-Habitat in 1992. Since then, he has looked after many different portfolios including: Slum upgrading, environmental infrastructure; health and environment; Water, Sanitation and waste management. In addition, he has been responsible for developing relationships with the regional development banks and the private sector. During this period, he has been on secondment to both the World Health Organisation (WHO), and UNHCR, where he has applied his expertise to preventative health in urban settings and humanitarian environments. The work has usually included both policy advice to members states and project design and implementation. He was responsible for the development of the UN-system wide monitoring mechanism for SDG 6 on Water, and also the co-custodian of indicator 6.3.1 on wastewater. He is currently the co-chair of the RBM End Malaria Now, Multi-sectoral working group, and is a Lancet Commissioner for the build-out of Aedes-borne diseases in cities. In addition, he represents UN-Habitat on many inter-agency bodies and advisory groups. He has also produced a variety of publications including global reports and technical papers in journals. He has over 35 years- experience in the urban sector and has worked in over 50 countries in all regions of the world.

Sylvain Aldighieri, M.D., is a French National. He earned an MD from the University of Marseille, is qualified in Tropical Medicine from the University of Paris, and has followed postgraduate studies in Epidemiology and Tropical Microbiology at the Institut Pasteur Paris. For about 30 years he was posted in various locations in Africa, South America, Central America, and the Caribbean as a Medical Officer for the French Government and for the Pan American Health Organization/World Health Organization (PAHO/WHO). During the past several years he has been reassigned to other various duties due to outbreaks such as Cholera in Haiti, Chikungunya and Zika in the Americas and Yellow Fever in Brazil. From January 2020 through May 2023 he served as the PAHO Incident Manager for COVID-19. Dr Aldighieri is the Director of the Communicable Diseases Prevention, Control and Elimination department at PAHO in Washington DC.

Oliver Brady, D.Phil, uses spatial statistical models to better understand the spread of mosquito-transmitted viruses and optimise strategies for their control and spans three main areas: (1) Mapping the global distribution of dengue, chikungunya and Zika and estimating their true burden to track progress towards global targets, (2) Understanding and predicting the geographic spread of dengue and Zika to design new strategies to contain the spread of pandemics, (3) Developing and optimising the use of novel interventions for dengue control including real time outbreak forecasting and accelerating the adoption of novel mosquito control tools like Wolbachia. To achieve these aims, he develops and apply advanced statistical and mechanistic models in Bayesian frameworks to high resolution climate, demographic and socioeconomic data. Key to his work is close collaboration with ministries of health and a partnership with WHO to develop strategies and guidelines that ultimately aim to contain these expanding arboviral diseases.

Thais dos Santos, M.S., is Regional Advisor for surveillance and response of arboviral diseases at the Pan American Health Organization (Regional Office of the World Health for the Americas), a post she has held for the

past six years. Before moving to into her current position, she managed the comprehensive communicable diseases portfolio in the PAHO office for Barbados and Eastern Caribbean Countries for four years. She has also worked on respiratory viral disease surveillance at PAHO from 2003-2010 as well as epidemic responses at PAHO since 2003—in the response to pandemic influenza H1N1, cholera, yellow fever, chikungunya, Zika, Ebola and COVID-19 among others.

Nuno Faria, Ph.D., is a Professor in Virus Genomic Epidemiology at the School of Public Health, Imperial College London, where he co-leads the Pathogen Genomic Epidemiology theme of the MRC Global Infectious Disease Analysis group. He also holds an Associate Professorship at the Department of Biology, University of Oxford, and a visiting Professorship at the University of São Paulo. He is part of the Technical Advisory Group for the WHO Global Arbovirus Initiative, and a member of the WHO Zika R&D Blueprint.

Duane J Gubler, ScD, FAAAS, FIDSA, FASTMH, is Emeritus Professor and founding director, Signature Research Program in Emerging Infectious Diseases at the Duke-NUS Medical School, Singapore. He is Adjunct Professor in his alma mater, Johns Hopkins Bloomberg School of Public Health, the Duke University School of Medicine and Duke Global Health Institute. He has spent his entire career working on tropical infectious diseases with an emphasis on dengue, Aedes-transmitted and other vector-borne diseases. He has extensive field experience in Asia, the Pacific, tropical America and Africa, and has published extensively on all aspects of dengue and other vector-borne infectious diseases, with over 450 publications and 2 books to his credit. Prof Gubler was founding Chief of the Dengue Branch, United States Centers for Disease Control and Prevention (CDC) in Puerto Rico for 9 years, Director of the Division of Vector-Borne Infectious Diseases, CDC in Fort Collins, Colorado for 15 years and Chair, Department of Tropical Medicine, Medical Microbiology and Pharmacology, University of Hawaii School of Medicine, in Honolulu for 5 years. He has and continues to serve on numerous WHO, national and international committees and study groups, and on the Scientific Advisory Boards of a number of companies and institutions. Prof Gubler was founding Chair, Board of Councilors, Pediatric Dengue Vaccine Initiative in Seoul, Korea, founding Chair, Partnership for Dengue Control in Lyon, France, and the founding Chair, Global Dengue and Aedes-transmitted Diseases Consortium, Singapore, for which he currently serves as Chairman. Prof Gubler is a Fellow, Infectious Disease Society of America, Fellow, American Association for the Advancement of Science, and Fellow and Past President of the American Society of Tropical Medicine and Hygiene.

Peter J. Hotez, M.D., Ph.D., is Dean of the National School of Tropical Medicine and Professor of Pediatrics and Molecular Virology & Microbiology at Baylor College of Medicine where he is also the Co-director of the Texas Children's Center for Vaccine Development (CVD) and Texas Children's Hospital Endowed Chair of Tropical Pediatrics. He is also University Professor at Baylor University, Fellow in Disease and Poverty at the James A Baker III Institute for Public Policy, Senior Fellow at the Scowcroft Institute of International Affairs at Texas A&M University, Faculty Fellow with the Hagler Institute for Advanced Studies at Texas A&M University, and Health Policy Scholar in the Baylor Center for Medical Ethics and Health Policy. Dr. Hotez is an internationally-recognized physician-scientist in neglected tropical diseases and vaccine development. As co-director of the Texas Children's CVD, he leads a team and product development partnership for developing new vaccines for hookworm infection, schistosomiasis, leishmaniasis, Chagas disease, and SARS/MERS/SARS-2 coronavirus, diseases affecting hundreds of millions of children and adults worldwide, while championing access to vaccines globally and in the United States. In December 2021, Dr. Hotez led efforts at the Texas Children's Center for Vaccine Development to develop a low-cost recombinant protein COVID vaccine for global health, resulting in emergency use authorization in India. He obtained his undergraduate degree in molecular biophysics from Yale University in 1980 (phi beta kappa), followed by a Ph.D. degree in biochemistry from Rockefeller University in 1986, and an M.D. from Weil Cornell Medical College in 1987. Dr. Hotez has authored more than 600 original papers and is the author of five single-author books, including Forgotten People, Forgotten Diseases (ASM Press); Blue Marble Health: An

Innovative Plan to Fight Diseases of the Poor amid Wealth (Johns Hopkins University Press); Vaccines Did Not Cause Rachel's Autism (Johns Hopkins University Press); and Preventing the Next Pandemic: Vaccine Diplomacy in a Time of Anti-science (Johns Hopkins University Press). Dr. Hotez served previously as President of the American Society of Tropical Medicine and Hygiene and he is founding Editor-in-Chief of PLoS Neglected Tropical Diseases. In 2006 at the Clinton Global Initiative he co-founded the Global Network for Neglected Tropical Diseases to provide access to essential medicines for hundreds of millions of people. He is an elected member of the National Academy of Medicine (Public Health Section) and the American Academy of Arts & Sciences (Public Policy Section). In 2014-16, he served in the Obama Administration as US Envoy, focusing on vaccine diplomacy initiatives between the US Government and countries in the Middle East and North Africa. In 2018, he was appointed by the US State Department to serve on the Board of Governors for the US Israel Binational Science Foundation, and is frequently called upon frequently to testify before US Congress. He has served on infectious disease task forces for two consecutive Texas Governors. For these efforts in 2017 he was named by FORTUNE Magazine as one of the 34 most influential people in health care, while in 2018 he received the Sustained Leadership Award from Research!America. In 2022 Hotez and his colleague Dr. Maria Elena Bottazzi were nominated for the Nobel Peace Prize for "their work to develop and distribute a low-cost COVID-19 vaccine to people of the world without patent limitation." Most recently as both a vaccine scientist and autism parent, he has led national efforts to defend vaccines and to serve as an ardent champion of vaccines going up against a growing national "antivax" threat. In 2019, he received the Award for Leadership in Advocacy for Vaccines from the American Society of Tropical Medicine and Hygiene. In 2021 he was recognized by scientific leadership awards from the AAMC (Association of American Medical Colleges) and the AMA (American Medical Association), in addition to being recognized by the Anti-Defamation League with its annual Popkin Award for combating antisemitism, and in 2023 he received the AAAS (American Association for the Advancement of Science) Award for Scientific Freedom and Responsibility for his "scientific work in vaccine development and his work as a public voice promoting and defending vaccines." Dr. Hotez appears frequently on television (including BBC, CNN, Fox News, and MSNBC), radio, and in newspaper interviews (including the New York Times, USA Today, Washington Post, and Wall Street Journal).

Laura Kramer, Ph.D., graduated from the University of Pennsylvania, completed her Ph.D. at Cornell Medical School and performed post graduate work at Gorgas Lab in Panama and the University of California, Berkeley. She served as an elected board member of American Society of Tropical Medicine and Hygiene, as well as invertebrate virology council member American Society of Virology, and was active on the American Committee on Arthropod-Borne Viruses as an executive council member. In response to the introduction of West Nile virus to the US in 1999, she was recruited to become Director, Arbovirus Laboratories, Wadsworth Center, New York State Department of Health and Professor in the Department of Biomedical Sciences, School of Public Health, State University of New York at Albany until her retirement in December 2020. She is currently Emeritus Professor at the University at Albany's School of Public Health. Dr. Kramer was Associate Editor International Journal of Infectious Diseases and moderated virus reports for ProMED (International Society Infectious Diseases) from 2015 - 2023. She continues to serve as a contributing author to Merck Manuals virus section. Her research efforts during her more than 50-year career focus on how the interactions between mosquitoes, viruses, and vertebrate hosts impact the intensity of viral transmission, and viral establishment, adaptation, and evolution. She has been continuously funded by NIH / NIAID since 1998 and has more than 230 peer reviewed publications, plus more than 30 invited chapters. Dr. Kramer just completed co-editing a book published by Springer on the history of arbovirology from a personal on the ground perspective. She has been the recipient of numerous awards including the RM Taylor award for lifetime achievement in arbovirology, the first recipient of the Lawrence Sturman award for scientific excellence, and two Fulbright awards.

Eve Lackritz, M.D., is Deputy Director of CIDRAP (Center for Infectious Disease Research and Policy) at the University of Minnesota. She has extensive experience in epidemiology and public health surveillance, research, and policy in the areas of infectious diseases and maternal-child health. Prior to CIDRAP, she served at the World Health Organization in Geneva as the Zika Task Force Lead, followed by clinical service roles as Hospital Director for Médecins Sans Frontières in the Rohingya refugee camp and Medical Director of the Rosebud Indian Health Service Hospital in South Dakota during the COVID-19 pandemic. Dr. Lackritz had a 23-year career at the Centers for Disease Control and Prevention (CDC), where she served as Branch Chief of the Maternal and Infant Health Branch. She worked the previous 10 years with the CDC's global HIV/AIDS programs, including implementation and evaluation of the first national AIDS treatment programs in Africa, clinical trials of antiretroviral therapy, and identification of new routes of transmission in Africa of HHV-8, the virus that causes Kaposi's sarcoma. She also served 5 years in the CDC's Malaria Branch, conducting epidemiologic and clinical studies of malaria, anemia, and child survival in sub-Saharan Africa. Dr. Lackritz received her MD at the Ohio State University and completed her residency in pediatrics at Case Western Reserve/University Hospitals of Cleveland.

Ng Lee Ching, Ph.D., is the Group Director of Environmental Health Institute (EHI) at the National Environment Agency in Singapore. She has spent more than 20 years building scientific capabilities for Singapore's environmental public health, conducting research to understand disease risk and transmission, and developing tools and strategies for mitigation of risks. She has co-authored more than 210 scientific papers and book chapters, in the area of vector borne diseases, COVID-19, food borne diseases, anti-microbial resistance, indoor air quality etc. She serves as an Adjunct Associate Professor at the Saw Swee Hock School of Public Health at National University Singapore, Adjunct Associate Professor at Nanyang Technological University of Singapore and as the Director of the WHO Collaborating Centre for Reference and Research of Arbovirus and their Associated Vectors.

Audrey Lenhart, PhD, MPH, is the Chief of the Entomology Branch at the U.S. Centers for Disease Control and Prevention in Atlanta, Georgia, USA. She is based in the Division of Parasitic Diseases and Malaria in the National Center for Emerging and Zoonotic Infectious Diseases, where she serves as a senior agency expert on public health entomology. The Entomology Branch provides technical assistance throughout the Americas, Asia, and Africa regarding vector surveillance and control, including co-implementing the U.S. President's Malaria Initiative (PMI) across its 30 focus countries. Dr. Lenhart serves as a senior advisor to PMI and coordinates CDC's activities in the USAID-funded Latin America and Caribbean Regional Malaria Program. She also leads the CDC VecNet Program, which supports regional public health entomology networks in 6 regions across the globe. She previously led the Entomology Branch's Insecticide Resistance and Vector Control Team, which includes a research group that focused on the biology and control of mosquitoes and laboratory activities centered on the molecular mechanisms that cause insecticide resistance in mosquito vectors of human disease. Dr. Lenhart is a founding member of PAHO's Technical Advisory Group for Public Health Entomology in the Americas and is co-chair of the WHO Vector Control Advisory Group. She is an Honorary Research Fellow at the Liverpool School of Tropical Medicine and adjunct faculty in the Department of Environmental Sciences at Emory University.

Steve Lindsay, Ph.D., is a public health entomologist and epidemiologist with a particular interest in the control of vector-borne diseases. Over the past 35 years he has have carried out field work in The Gambia, China, Ethiopia, Kenya, Laos PDR, Pakistan, Tanzania, Thailand and Uganda and published 275 peer-reviewed papers, many in high impact journals. He was a lead writer of two of the World Health Organisation's (WHO) recent strategy documents: (1) the 'Global Vector Control Response 2017-2030' and (2) the 'Global framework for the response to malaria in urban areas.' He also co-wrote WHO's 'Toolkit for Integrated Vector Management for sub-Saharan Africa'. He has an Honorary chair at the London School of Hygiene and Tropical Medicine.

Linda Lloyd, Dr.PH, M.P.H, is a social scientist specializing in the design and evaluation of behavioural and community-centered health programs that reflect local socio-ecological contexts. She has worked with PAHO and WHO for over twenty-five years to strengthen ministry of health capacity in behavior change and risk communication for the prevention and control of vector-borne diseases through technical assistance, workshops, and training courses. Dr. Lloyd is a member of the Lancet Commission on Aedes-transmitted Viral Diseases (2019 to date) and the PAHO/WHO External Evaluation Group of New Technologies for Aedes spp. Control (2017 to date). She served on the PAHO/WHO Regional Lymphatic Filariasis Elimination Program Review Group (2008 to 2015), WHO-TDR Research Reference Group on Dengue and Other Viral Diseases of Major Public Health Importance (2009 to 2011), and the TDR/WHO Scientific Working Group on Dengue (2001, 2006). Dr. Lloyd is Adjunct Faculty at SDSU School of Public Health. She taught Global Health (PH780) from 2015 to 2020 and continues as a guest lecturer. She was the Director of the Center for Research at San Diego Hospice, where she was responsible for oversight of psychosocial research and clinical trials to improve patient care.

James Lloyd-Smith, Ph.D., is Professor in the Departments of Ecology & Evolutionary Biology and Computational Medicine at the University of California, Los Angeles (UCLA). His research program explores the drivers of infectious disease in animal and human populations, with emphasis on emergence of zoonotic pathogens. His group combines mathematical models, statistical analysis, and laboratory, clinical and field studies to study diseases including covid-19, mpox, leptospirosis, and influenza. He chaired the NIH RAPIDD working group on pathogen emergence, and served as external advisor to the World Health Organization on the R&D Blueprint list of Priority Pathogens posing epidemic or pandemic threats. Currently he is a member of the Lancet/PPATS Commission on Prevention of Viral Spillover, and co-lead of its Working Group on Scientific Evidence.

Kariuki Njenga. Ph.D., is Professor of Infectious Diseases at Washington State University (WSU), with adjunct appointment as Chief Research Officer at Kenya Medical Research Institute (KEMRI). He is a member of the US National Academy of Medicine and based full-time in Kenya. Dr Njenga holds a Bachelor of Veterinary Medicine and Master of Science degrees from the University of Nairobi, Kenya, and a PhD from the Pennsylvania State University, USA. Dr Njenga obtained 5 years of post-doctoral training at the Mayo Clinic, Rochester, Minnesota, and faculty experience at the University of Minnesota. His background training is in virology and immunology, but he has gained experience conducting field studies on emerging infectious diseases (EIDs) over the past 18 years, resulting in publication of >200 manuscripts. Between 2004-2011 (8 years), Dr Njenga served as Laboratory Director of the US/CDC in East Africa, establishing, and equipping the laboratory and providing diagnostic support for outbreaks in the horn of Africa and East Africa (Kenya, Somalia, Sudan, Ethiopia, Tanzania, Uganda, and Rwanda) such as Rift Valley fever and other viral hemorrhagic fevers, Avian influenza, Hepatitis E, Leptospirosis, and anthrax. At CDC, Dr Njenga worked with epidemiologists to establish a population-based health surveillance (PBHS) platform for acute febrile illness, jaundice, respiratory illness and diarrheal among urban and rural populations. Between 2011 and 2014, Dr Njenga served as head of the One Health (OH) Program at CDC-Kenya and the Kenya Medical Research Institute (KEMRI), focusing on establishing a multisectoral OH approach (setting up policies, institutions, and research) that enhanced Kenya's efforts in preventing and controlling zoonotic diseases. For OH research, he focused on conducting systematic burden of disease studies on priority episodic and endemic zoonotic diseases in the East Africa region, and studies at the animal-human-environment interface in order to elucidate the mechanisms of animal-to-human transmission. His recent studies are focused on understanding the maintenance, transmission, and long-term clinical sequalae of Rift valley fever virus (RVFV), Middle East respiratory syndrome coronavirus (MERS-CoV), and Ebolavirus in East and Central Africa.

Eng Eong Ooi BMBS, PhD, FRCPath, is a professor in the Programme in Emerging Infectious Diseases, Duke-NUS Medical School; Associate Dean (Early Research Career Development) in the Office of Academic Medicine, Duke-NUS Medical School; Professor at the Saw Swee Hock School of Public Health, National University of

Singapore; and Co-Director of the Viral Research and Experimental Medicine Centre, SingHealth Duke-NUS Academic Medical Centre. Dr. Ooi trained in medicine at the University of Nottingham and completed his PhD studies on molecular epidemiology at the National University of Singapore. His research interest includes dengue pathogenesis and host response to virus infection and vaccination. His laboratory integrates clinical studies with basic virology and immunology to gain deeper understanding of dengue pathogenesis and immunity. He received the Clinician-Scientist (Senior Investigator) Awards in 2010, 2014 and 2019, and was recently awarded the Singapore Translational Research Award, all by the National Medical Research Council of Singapore. He is a member of the Scientific Advisory Board of Science Translational Medicine and an Editorial Board member of PLoS Biology.

Gabriela Paz-Bailey, MD, PhD, MSc, DTM&H, is the Chief of the Dengue Branch (DB), Division of Vector-Borne Diseases (DVBD), National Center for Emerging and Zoonotic Infectious Diseases (NCEZID) in San Juan, Puerto Rico. Dr. Paz-Bailey completed a degree in Medicine and Surgery at the University of San Carlos of Guatemala. She continued her graduate studies at the London School of Hygiene and Tropical Medicine in London, England, where she pursued a Master of Science in Tropical Medicine and International Health, and a PhD in Clinical Epidemiology. She joined the Centers for Disease Control and Prevention (CDC) in 2000 as an Epidemic Intelligence Service Officer. Dr. Paz-Bailey has over two decades of experience in public health and epidemiology in the United States, Central America, Africa, and Asia. She has studied the natural history of several infectious diseases, focusing on their acquisition and response to therapies. These include tuberculosis, Chagas disease, HIV, hepatitis B and C viruses, herpes viruses, and arboviral diseases such as dengue and Zika. She has focused her efforts on strengthening surveillance systems and comprehensive treatment and prevention programs and has authored over 190 publications. She now leads dengue research and program development for the CDC, including dengue transmission dynamics, evaluation of novel mosquito control interventions, and dengue vaccine policy and implementation. Dr. Paz-Bailey is passionate about working on disease control and prevention and the use of science-based tools to improve public health.

Valerie A. Paz-Soldan, PhD, MPH, is Associate Professor in the Tropical Medicine and Infectious Disease Department at the Tulane University School of Public Health and Tropical Medicine, and Director of Tulane's Health Office for Latin America (HOLA) in Lima, Peru, where she has been based permanently since 2004. She is a Peruvian-American social scientist who works with interdisciplinary teams applying both qualitative and quantitative research methods to improve knowledge of: 1) human behaviors (at the individual and organizational levels) associated to vector borne disease transmission, prevention and control, especially dengue, and 2) implementation science approaches applied to health care systems and policy in Peru. Her current work applies implementation science and systems thinking approaches to understand health problems, develop locally appropriate interventions, and translate evidence into practice, working primarily in the Amazon rainforest city of Iquitos, Peru.

Rosanna Peeling, Ph.D., is Professor Emeritus at the London School of Hygiene and Tropical Medicine, and the University of Manitoba, Canada, and the founding Director of the International Diagnostic Centre (IDC) Network. Trained as a medical microbiologist, she previously held positions as the Chief of the Canadian National Laboratory for Sexually Transmitted Diseases, Research Coordinator and Head of Diagnostics Research at the UNICEF/UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases in Geneva. Her research focuses on defining unmet diagnostic needs and facilitating test development, evaluation and implementation. She established the IDC to advocate the value of diagnostics, foster innovation, and accelerate access to quality-assured diagnostics. Professor Peeling has served on WHO guideline development groups for HIV, Hepatitis, dengue and as a member of many expert advisory committees, including the WHO Strategic Advisory Group of Experts on In Vitro Diagnostics (SAGE IVD), the Global Validation Advisory Committee for the

Elimination of Mother-to-child Transmission of HIV, Syphilis and Hepatitis B, the WHO STI POC Test Initiative, the US National Academies of Science, Engineering and Medicine's Committee on Public Health Interventions and Countermeasures for Advancing Pandemic and Seasonal Influenza Preparedness and Response, the G20 Summit Task Force advisory group and the Africa CDC Laboratory Working Group. Prof Peeling was awarded the Royal Society of Tropical Medicine and Hygiene's George MacDonald Medal for outstanding contribution to tropical medicine in 2014 and made an Honorary Fellow of the Society in 2021.

Segaran Pillai, Ph.D., M.S., FAAM, currently serves as the Designated Agency Safety and Health Official and the Director of the Office of Laboratory Safety (OLS) at the Food and Drug Administration. In this capacity he responsible for providing executive leadership in the areas of laboratory science and employee safety and health, which includes implementing laboratory safety and laboratory security policies and practices across the Agency; oversight and monitoring for FDA's safety program including routine and ad-hoc inspections; serving as the Agency liaison for employee and laboratory safety to HHS Operating Divisions (OPDIVS) and components of HHS, other federal agencies, and the scientific community; implementing a robust Laboratory Quality Management System (LQMS) to ensure the integrity and quality of data and results support FDA's regulatory mission; and conducting and funding appropriate applied research to enhance laboratory science, laboratory security, and Agency-wide safety. Before joining FDA, Dr. Pillai served as the Chief Medical and Scientific Advisor in the Science and Technology (S&T) Directorate at the U.S. Department of Homeland Security (DHS). In this role, he served as an advisor for all DHS S&T initiatives to deter, detect, or mitigate a biological attack on the nation. Dr. Pillai also served on the White House Biodefense Policy Committee while supporting DHS. Prior to this position, Dr. Pillai served as the Director of the State Public Health Laboratory in Miami Florida, and the Clinical Services Director for the Miami-Dade County Health Department. He also served as an Assistant Professor at the University of Miami School of Medicine and Florida International University. Prior to this, he served as an Assistant Professor of Research at the University of Kansas, where he received his Ph.D. in Molecular Genetics. Dr. Pillai is a Board-Certified Clinical Microbiologist by the American Academy of Microbiology and a Specialist Microbiologist by the American Society for Clinical Pathology. He is also a Fellow of the American Academy of Microbiology and is also licensed in the State of Florida as a Clinical Laboratory Director in areas of Microbiology, Serology, Clinical Chemistry, Hematology, Immunohematology, Cytology, Cytogenetics, and Molecular Genetics. While in Florida, he played a very critical role in public health and was instrumental in developing a model Public Health Program which encompasses Rapid Molecular Diagnostics and pro-active approach to Epidemiology and Diseases Surveillance to support rapid intervention which was recognized by Centers for Disease Control and Prevention (CDC). Dr. Pillai played a vital role as one of the lead investigators during the 2001 anthrax attack in the United States. His critical role was recognized nationally by the Florida Department of Health where he received the Certificate of Commendation in 2003 from the Florida Department of Health; Robert D. May Award in recognition for significant accomplishments in the advancement of Public Health in 2004; Proclamation from Miami-Dade County for his Public Health Services in 2003; Agency for Toxic Substance and Disease Registry (ATSDR) award in recognition for the valuable laboratory contributions to the forensic examination of the Anthrax attack at the AMI Building, Boca Raton, Florida in 2002; the Iceberg Award in 2001 from the Department of Justice (FBI); the United State Postal Service Award, in May 2003 from the United State Postal Inspection Services and numerous awards and recognition from the Food and Drug Administration. In recent years, he received the FDA Commissioner's Special Recognition Award in 2018 and 2019; the FDA Commissioner's Administrative Management Award in 2018; the FDA Commissioner's Award of Excellence in 2019; the FDA Commissioner's Special Citation Award in 2022 and 2023; the Health and Human Services Secretary's Career Achievement Award in 2021; the HHS Secretary's Award for Distinguished Service in 2023; the HHS Secretary's Award for Distinguished Service - Poliovirus Containment Team Award in 2023; and numerous other awards at the FDA.

Diana Rojas, M.D., Ph.D., is a Medical Doctor with a Masters in Tropical Infectious Diseases and a PhD in infectious diseases Epidemiology. She has accumulated experience in arboviral diseases epidemiology and public health throughout her career, including surveillance, preparedness, prevention, outbreak control activities in developing countries, research, and control programs at national, regional and global levels. In June 2020, she joined WHO as the technical lead for chikungunya and Zika in the Emerging Diseases and Zoonosis unit at the Epidemic and Pandemic Preparedness and Prevention Department at the World Health Organization. Since then, she has been contributing actively to the development of the WHO global arbovirus initiative, global networks with Regional Offices for the surveillance, monitoring, prevention, treatment, and control of emerging arboviral diseases.

Thomas W. Scott, Ph.D., is a Distinguished Professor of mosquito transmitted disease ecology and epidemiology at the University of California, Davis. He received his Ph.D. in ecology from the Pennsylvania State University and was a post-doctoral fellow in epidemiology at the Yale School of Medicine. After initially examining the relationship of mosquito ecology to pathogen transmission in Southeast Asia, Latin America, and Africa in the early 1990s, in an effort to strengthen the public health connection of his work, he began longitudinal epidemiological studies in Thailand and Peru that lasted for more than twenty-five years. He currently focuses on assessing recommendations for mosquito-borne disease prevention, testing assumptions in public health policy, and developing innovative, cost, and operationally effective concepts for disease prevention. At UC Davis he was Director of the Center for Vector-Borne Disease Research and the Davis Arbovirus Research Unit. He chaired the Mosquito-Borne Disease Working Group in the Research and Policy in Infectious Disease Dynamics (RAPIDD) program, which developed novel mathematical modeling frameworks and reported to the Science and Technology Directorate, Department of Homeland Security, and Fogarty International Center at NIH. At the World Health Organization he chaired the Vector Control Advisory Group, co-chaired the Global Vector Control Response, chaired the Emergency Response Consultation for Zika Virus, chaired the Technical Working Group for Dengue, serves on the Technical Advisory Group for the Global Arbovirus Initiative, and serves on the International Health Regulators Roster of Experts. He is a member of the Management Committee for the Global Dengue and Aedes-Transmitted Diseases Consortium and is a member of the Executive Committee for the Lancet Commission on Aedes-transmitted Diseases.

Erin Staples, M.D., Ph.D., is a medical epidemiologist at the U.S. Centers for Disease Control and Prevention (CDC) in the Arboviral Diseases Branch located in Fort Collins, Colorado. She oversees the surveillance of domestic arboviral diseases, provides guidance for clinical care, testing, and prevention of arboviral diseases, develops arboviral vaccine recommendations, and conducts epidemiologic evaluations and research both domestically and internationally. Her past work experiences include lead of CDC's Arboviral Diagnostic and Reference Laboratory, bacterial zoonotic diseases work at CDC, vaccine development in industry, and clinical work in pediatric infectious diseases. Dr. Staples has both a medical degree and a doctoral degree in microbiology and immunology and has published on a variety of scientific subjects, including more than 150 articles and book chapters on arboviral diseases.

Nikos Vasilakis, Ph.D., M.A., is the Vice Chair for Research in the Department of Pathology at UTMB. He earned his BA and MA degrees in biology from Hofstra University and his PhD in arbovirology from the University of Texas Medical Branch, Galveston. His research interests have been to understand the evolution and pathogenesis of arthropod-borne viruses as well as virus–mosquito and virus–host interactions. He has served as chair of the American Committee on Arthropod-Borne Viruses and is the current chair of the Subcommittee on the Interrelationships Among Catalogued Arboviruses. He currently leads The Coordinating Research on Emerging Arboviral Threats Encompassing the Neotropics (CREATE-NEO), one of the Centers for Research In Emerging Infectious Diseases (CREID) funded by the National Institutes of Health.

Raman Velayudhan, Ph.D., M.Sc., is the unit head for Veterinary Public Health, Vector Control and Environment unit (VVE) on the Global Neglected Tropical Diseases Programme (UCN/NTD) at WHO/HQ. He is also the global focal point for dengue prevention and control, Integrated Vector Management of NTD vectors and coordinates dengue and other arbo-viral vector borne disease control activities at WHO. In his present assignment he also supports the organization of Vector Control Advisory Group and the implementation of vector surveillance and control at the points of entry under the International Health Regulations (2005). He joined WHO in 1989 and has worked in Solomon Islands, Fiji and the Philippines. His field of expertise includes malaria control, dengue and other arboviruses and neglected tropical diseases.

Anne Wilson, Ph.D., M.Sc., is an infectious disease epidemiologist. She uses mixed methods to understand the risk of vector-borne diseases and develop novel vector control methods. In particular, she is interested in the impact of anthropogenic changes such as urbanisation on vector-borne disease transmission, and the development of targeted, multi-sectoral control approaches. Anne has a PhD from Durham University and an MSc in Public Health from the London School of Hygiene and Tropical Medicine.

The National Academies' Statement on Preventing Discrimination, Harassment, And Bullying: Policy for Participants in NASEM Activities (Updated December 2, 2021)

The National Academies of Sciences, Engineering, and Medicine (NASEM) are committed to the principles of diversity, inclusion, 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 policy 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.

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 at the time the incident occurs, 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 hrservicecenter@nas.edu, 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.**

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.

The National Academies' Statement on Diversity and Inclusion

The National Academies of Sciences, Engineering, and Medicine value diversity in our members, volunteers, and staff and strive for a culture of inclusion in our workplace and activities. Convening a diverse community to exchange ideas and perspectives enhances the quality of our work and increases our relevance as advisers to the nation about the most complex issues facing the nation and the world.

To promote diversity and inclusion in the sciences, engineering, and medicine, we are committed to increasing the diversity of the National Academies' staff, members, and volunteers to reflect the populations we serve. We pledge to cultivate an environment and culture that promotes inclusion and values respectful participation of all individuals who help advance the mission of the institution.