

FORUM ON MICROBIAL THREATS

Assessing the Burden and Potential Strategies to Address Antimicrobial Resistance: A Workshop

March 4-5, 2024 | 12:00–4:15 PM EST | Virtual

BRIEFING BOOK



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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

Sponsors

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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](#).

Upcoming Events from the Forum

ACCELERATING THE USE OF PATHOGEN GENOMICS AND METAGENOMICS IN PUBLIC HEALTH: A WORKSHOP

June 10-11, 2024 | Washington, D.C.

High-throughput and genome sequencing technologies have enabled the use of pathogen genomics and metagenomics as powerful data-driven disease surveillance approaches. These epidemiological tools have been critical in addressing emerging outbreaks and evolving pathogens from foodborne infections to SARS-CoV-2. The Forum in Microbial Threats will host a public workshop to examine how genomics and metagenomics have been applied to infectious diseases surveillance and response. In addition, this workshop will examine opportunities to integrate pathogen genomics tools and techniques more broadly into the public health system to improve the effectiveness of surveillance and response to diseases.

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

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

Elizabeth D. Hermesen, Pharm.D., M.B.A.
Pfizer

Keith P. Klugman, M.D., Ph.D.
Bill & Melinda Gates Foundation

Albert I. Ko, M.D.
Yale School of Public Health

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 Obregón, 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., FCCP
St. Jude Children's Research Hospital

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

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 Staff

Julie Pavlin, M.D., Ph.D., M.P.H.
Director, Board on Global Health
JPavlin@nas.edu

Julie Liao, Ph.D.
Forum Director
JLiao@nas.edu

Elizabeth Ashby, M.Sc.
Program Officer
Eashby@nas.edu

Claire Biffi
Research Associate

CBiffi@nas.edu

Taylor Windmiller
Senior Program Assistant
TWindmiller@nas.edu

Workshop Agenda

MONDAY, MARCH 4, 2024

DAY I Assessing the Burden of AMR

12:00pm Welcome Remarks, Workshop Overview, and Goals

- **Introduction and Workshop Overview:** Jomana Musmar, U.S. Department of Health and Human Services

Workshop chair

12:15pm Patient Perspective

- Ken Opengart, Tyson Foods

12:30pm Session 1: Impact of AMR Across Medical Practice

Panel Moderator: Helen Boucher, Tufts University

- **Decolonization to Address Antimicrobial Resistance in Skilled Nursing Facilities:** Susan Huang, University of California, Irvine
- **Addressing Surgical Antimicrobial Overuse through Hospital-Level Benchmarking, Accountability, and Prioritization of Stewardship Efforts:** Shawn Rangel, Boston Children's Hospital
- **The Impact of Antimicrobial Resistance on Oncology Practice:** John Wingard, University of Florida
- **Q&A**

1:30pm BREAK

1:45pm Session 2: Monitoring AMR in Plants, Animals, and the Environment

Do we truly understand the interconnectedness of the One Health sectors to AMR and how do we optimally bridge knowledge-to-action with limited resources?

Panel Moderator: Ramanan Laxminarayan, One Health Trust

- **Environmental Dimensions and Wastewater Surveillance:** Joakim Larsson, University of Gothenburg
- **Complexity of Monitoring and Comparing Data across One Health:** Paul Plummer, Iowa State University College of Veterinary Medicine
- **Quadripartite Collaboration for Multi-Sectoral Action on AMR:** Suzanne Young, World Health Organization
- **Q&A**

2:45pm BREAK

3:00pm **Session 3: Making Meaning from Metrics: What's at Stake?**

Is the full scope of AMR being captured and quantified, and how?

Panel Moderator: Chris Braden, U.S. Centers for Disease Control and Prevention

- **Global Surveillance of AMR: Complementary Methods to Address Global Data Scarcity:** Olga Tosas Auguet, World Health Organization
- **Addressing Antimicrobial Resistance: Investing in Prevention and Measuring Success:** Dawn Sievert, U.S. Centers for Disease Control and Prevention
- **Burden of AMR-Associated Infections Preventable by Interventions:** Joseph Lewnard, University of California, Berkeley
- **Q&A**

4:00pm **Synthesis and Adjourn**

- Matthew Zahn, Orange County Health Care Agency
 - Jomana Musmar, U.S. Department of Health and Human Services
- Workshop chair*

TUESDAY, MARCH 5, 2024

DAY II **Improving Strategies to Address AMR**

12:00pm **Welcome Remarks, Review of Day 1**

- Jomana Musmar, U.S. Department of Health and Human Services
- Workshop chair*

12:15pm **Patient Perspective**

- Anthony Darcovich, World Health Organization AMR Survivors Taskforce

12:30pm **Session 4: Stewardship**

Envision the future: 10 years from now, what will we have done that will have gotten us to the place we ideally need to be, what is intended outcome and measure, how do we reach it?

Panel Moderator: Julia Szymczak, University of Utah

- **Outpatient Telehealth and Antimicrobial Stewardship:** Kristin Ray, UPMC Children's Hospital of Pittsburgh
- **Diagnostics as a Resistance Combatting Strategy:** Robin Patel, Mayo Clinic
- **Challenges and Opportunities in Inpatient Antimicrobial Stewardship:** Ritu Banerjee, Vanderbilt University Medical Center
- **Q&A**

1:30pm **BREAK**

1:45pm

Session 5: Access

How do we make access work? Dissecting different degrees of access issues and draw compare/contrast (if appropriate) between global vs US settings.

Panel Moderator: Elizabeth Hermesen, Pfizer

- **Protecting Pharmaceutical Supply Chains in LMICs:** Anthony McDonnell, Center for Global Development
- **Appropriate Access to Existing and Novel Antibiotics:** Jennifer Cohn, Global Antibiotic Research & Development Partnership
- **Sustainable Use of Available Medicines:** Esmita Charani, University of Cape Town
- **Q&A**

2:45pm

BREAK

3:00pm

Session 6: Innovation

How do we ensure truly new candidates are entering trials and getting into clinical use?

Panel Moderator: Greg Frank, Merck & Co.

- **Artificial Intelligence for Antibiotic Discovery:** James Collins, Massachusetts Institute of Technology
- **The TB Drug Accelerator: A Public-Private Model for Antibiotic Development:** Ken Duncan, Bill & Melinda Gates Foundation
- **Supporting New Antimicrobials in Clinical Use:** Ramy Elshaboury, Massachusetts General Hospital
- **Q&A**

4:00pm

Synthesis and Adjourn

- Jomana Musmar, U.S. Department of Health and Human Services
Workshop chair

Workshop Planning Committee

**Jomana Musmar, Ph.D., M.S.,
(chair)**

Designated Federal Officer and
Executive Director
Presidential Advisory Council on
Combating Antibiotic Resistant
Bacteria

Christopher Braden, M.D.*

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

Greg Frank, Ph.D.*

Director, Global Public Policy
Merck

**Elizabeth D. Hermsen,
Pharm.D., M.B.A.***

Senior Medical Director of
Launch Excellence
Pfizer

Ramanan Laxminarayan, Ph.D.

Founder and Director
One Health Trust

Robin Patel, M.D.

Director, Infectious Diseases
Research Laboratory
Mayo Clinic

Julia Szymczak, Ph.D.

Associate Professor
University of Utah School of
Medicine

Matthew Zahn, M.D.*

Deputy Health Officer
Orange County Health Care
Agency

* Member, Forum on Microbial Threats

Note: This event was planned by the experts appointed to the planning committee. The planning committee's role is limited to organizing the event. A proceedings-in-brief based on the event will be prepared by an independent rapporteur.

Speaker Biographies

Ritu Banerjee

Ritu Banerjee, M.D., Ph.D., is Professor in the Division of Pediatric Infectious Diseases at Vanderbilt University Medical Center. She is the Director of the Pediatric Antimicrobial Stewardship Program and Interim Director of Pediatric Infectious Diseases at Vanderbilt. She received her MD and Ph.D. degrees from Washington University in St. Louis and then completed Pediatrics residency and Pediatric Infectious Disease fellowship at the University of California, San Francisco. She is a member of many national committees through the Pediatric Infectious Diseases Society, the American Academy of Pediatrics, the Infectious Diseases Society of America, and the Antibacterial Resistance Leadership Group. Dr. Banerjee conducts clinical research about antibiotic stewardship, implementation and outcomes of rapid blood culture diagnostics, and enhanced detection of carbapenem-resistant organisms.

Esmita Charani

Esmita Charani, Ph.D., M.Sc., M.Pharm., MRPSGB, is an Associate Professor at the University of Cape Town where she is undertaking a Wellcome Trust Career Development Fellowship in intersectional research in antimicrobial resistance (AMR) (2023-2027). In the UK, she is an Honorary Reader in Infectious Diseases, AMR and Global Health at the University of Liverpool. She is a visiting Researcher at Haukeland University Hospital, Bergen Norway, and Adjunct Professor at Amrita Institute of Medical Sciences, Kerala India, where she is involved in helping implement and investigate national antibiotic stewardship programmes. Her work in AMR has been recognised through the Academy of Medical Sciences UK-India AMR Visiting Professor award. She is involved in mentoring and supporting clinical pharmacists across different healthcare settings and economies in implementing antimicrobial stewardship interventions.

Jennifer Cohn

Jennifer Cohn, M.D., is an infectious disease physician with a focus on improving access to and uptake of effective health products and models of care in low- and middle-income countries. She currently serves as the Director, Global Access for the Global Antibiotic Research and Development Partnership (GARDP), and is a clinical associate professor of Infectious Diseases and Scholar at the Center for Global Health at the University of Pennsylvania School of Medicine. Before joining GARDP, Jennifer served as Senior Vice President for cardiovascular health at Resolve to Save Lives, Senior Director of Innovation at the Elizabeth Glaser Pediatric AIDS Foundation, and as the Medical Coordinator for the Doctors Without Borders (MSF) Access Campaign. Jennifer has served on international advisory groups for TB, HIV, non-communicable diseases and viral hepatitis. She has published over 80 papers in peer-reviewed medical journals. Jennifer received her MD from University of Pennsylvania, is board certified by the American Board of Internal Medicine in Internal Medicine and Infectious Diseases and earned her Masters in Public Health at the Johns Hopkins School of Public Health.

James Collins

James Collins, Ph.D., is the Termeer Professor of Medical Engineering & Science and Professor of Biological Engineering at MIT, as well as a Member of the Harvard-MIT Health Sciences & Technology Faculty. He is also a Core Founding Faculty member of the Wyss Institute for Biologically Inspired

Engineering at Harvard University, and an Institute Member of the Broad Institute of MIT and Harvard. He is one of the founders of the field of synthetic biology, and his research group is currently focused on using synthetic biology to create next-generation diagnostics and therapeutics. Professor Collins' patented technologies have been licensed by over 25 biotech, pharma, and medical devices companies, and he has co-founded a number of companies, including Synlogic, Senti Biosciences, Sherlock Biosciences and Cellarity, as well as Phare Bio, a non-profit focused on AI-driven antibiotic discovery. He has received numerous awards and honors, including a MacArthur "Genius" Award and the Dickson Prize in Medicine, and he is an elected member of all three national academies - the National Academy of Sciences, the National Academy of Engineering, and the National Academy of Medicine.

Anthony Darcovich

Anthony first injured his right shoulder when he was playing baseball as a teenager. He had to undergo several surgeries over the next few years to relieve the pain, but the pain persisted. Twelve years after his ordeal started, his shoulder joint samples grew *Cutibacterium acnes*, a slow growing bacteria usually implicated in acne. Since it was resistant to Clindamycin, he had to take 8 months of injectable and oral antibiotics to get rid of the infection, apart from many other surgeries, one of which damaged his axillary nerve. He had to undergo several muscle transfer surgeries to regain part of his muscle function. Right now, he is recovering from his 19th surgery! Anthony is now a patient advocate and works as a management consultant with McKinsey in New York.

Ken Duncan

Ken Duncan, Ph.D., leads the drug discovery program at the foundation across therapeutic areas currently including TB, malaria, antivirals and contraception. Before joining the foundation in 2007, Ken spent 16 years in the pharmaceutical industry, most recently as Director, Diseases of the Developing World at GlaxoSmithKline, and two years as a consultant to the Gates Foundation and a project manager at Imperial College, London. At the foundation, Ken established the TB Drug Accelerator, a new model of collaboration across industry, academia, and non-profit drug discovery teams. The model has been adapted and applied in other areas to facilitate collaboration and speed up discovery research. Ken played a major role in launching the Global Health Drug Discovery Institute in Beijing, China. He currently serves on the Selection Committee of the Global Health Innovative Technology Fund in Japan and is a member of the Governing Board of the Tres Cantos Open Lab Foundation in Spain. Ken received a BSc in Molecular Biology from the University of Edinburgh and a PhD from the University of Glasgow. He carried out postdoctoral research at Massachusetts Institute of Technology and Harvard Medical School.

Ramy Elshaboury

Ramy Elshaboury, Pharm.D., BCPS, BCIDP, is the Director of Clinical Pharmacy Services and Graduate Pharmacy Education at Massachusetts General Hospital. Dr. Elshaboury provides leadership oversight for inpatient and outpatient clinical pharmacy services, along with the various pharmacy residency programs, focusing on efficient, timely and optimal pharmaceutical care. He serves as the Residency Program Director for the PGY-2 Infectious Diseases Pharmacy Residency.

Dr. Elshaboury earned his Doctor of Pharmacy degree from the University of Minnesota College of Pharmacy. He completed PGY-1 Pharmacy and PGY-2 Infectious Diseases residency training at Abbott Northwestern Hospital (part of Allina Health) in Minneapolis, Minnesota. He is a board-certified pharmacotherapy specialist and board-certified infectious diseases pharmacist.

Susan Huang

Susan Huang, M.D., M.P.H., is Chancellor's Professor of Medicine in the Division of Infectious Diseases at the University of California Irvine (UCI) School of Medicine, and Medical Director of Epidemiology and Infection Prevention at UCI Health. For the past 20 years, Dr. Huang has been studying healthcare-associated infections with a focus on multidrug-resistant organisms (MDROs), including preventative strategies for containment. Dr. Huang has studied regional spread and prevention of MDROs in hospitals and nursing homes and has led several large randomized clinical trials involving decolonization across the continuum of care. Dr. Huang has over 200 publications and has served as a past member of the Healthcare Infection Control Practices Advisory Committee (HICPAC), the CDC Antibiotic Resistance Working Group, and the IDSA Antibiotic Resistance Committee. She is a current member of the Presidential Advisory Council for Combating Antibiotic Resistant Bacteria.

Joakim Larsson

Joakim Larsson, Ph.D., is a Professor in Environmental Pharmacology at the Department of Infectious Diseases, University of Gothenburg, in Sweden. He received his PhD in animal physiology in 2000 in Gothenburg. After two years of guest research in Canada and the USA, he decided to come back to Gothenburg and combine his interest for the environment with medicine. He became associate professor in human physiology in 2007 and full professor in 2013. From 2016 he is director for the multidisciplinary Centre for Antibiotic Resistance Research (CARE) in Gothenburg hosting 150 scientists from 22 departments. His own research group focusses on the environmental dimensions of antibiotic resistance. Larsson has (co)-authored over 200 papers, and he is among the 1% most highly cited researchers on Web of Science since 2018. His work on environmental pollution from drug manufacturing, and his research on selective concentrations of antibiotics has contributed various management initiatives across the world. He acts as scientific advisor on AMR issues to, for example, the JPIAMR, the Swedish minister of Social Affairs, and the Access to Medicines foundation. He is currently also work as a consultant for the WHO.

Joseph Lewnard

Joseph Lewnard, Ph.D., is an Associate Professor of Epidemiology at the University of California, Berkeley, and Co-Principal Investigator of the California Center for Outbreak Readiness, a CDC-funded Center for Innovation in infectious disease modeling and analytics. He has led studies of the efficacy and effectiveness of numerous vaccines in reducing antibiotic use in both low- and high-resource settings, with ongoing work aiming to characterize the relationship between antibiotic use and resistance to inform AMR mitigation strategies. He is a member of 2022-24 cohort of the Emerging Leaders in Health and Medicine Fellowship of the US National Academy of Medicine.

Anthony McDonnell

Anthony McDonnell, M.P.A., is a senior policy analyst in the Center for Global Development's global health policy team. He leads CGD's work on antimicrobial resistance (AMR), including modelling the macro-economic burden of AMR and was previously the technical lead of CGD's working group, A New Grand Bargain to Improve the Antimicrobial Market for Human Health. He has also led projects analysing the COVID-19 vaccine portfolio, examining policy interventions to protect the supply chains for pharmaceuticals from COVID-19-induced shocks, and contributed to the international Decision Support Initiative's work in Ethiopia.

Before joining CGD, he was Head of Economic Research for the UK's Independent Review into AMR which

was set up by the UK government and the Wellcome Trust; led a Wellcome Trust project examining how it could fund more economic research; a research associate at ODI working on the political economy of why governments role out health services in LMICs, (particularly those aimed at reaching the left behind); and a senior health economist at the University of Oxford, modelling the cost of malaria interventions.

Ken Opengart

Ken Opengart, D.V.M., Ph.D., DACPV, 's personal mission throughout his professional career has been to actively contribute to an agricultural system that provides safe and sustainable, high quality, affordable protein to millions of global consumers. As a veterinarian, this includes embracing the core tenets of the veterinary oath - protection of animal health and welfare, the prevention and relief of animal suffering, the conservation of animal resources, the promotion of public health and the advancement of medical knowledge. Working within animal agriculture for over 25 years, Ken has held a variety of roles including leading live operations, commodity risk management, poultry health and nutrition, animal welfare, pre-harvest food safety and sustainability for several global food companies. Over the last half of his career, he has provided leadership and focus in the areas of animal welfare and sustainability in the food animal sector. Today, he leads enterprise-wide animal welfare and international sustainability for Tyson Foods.

Ken has served as past-president of the American College of Poultry Veterinarians, is a past-chair of the American Association of Avian Pathologists' Animal Welfare Committee, a founding board member and past chair of the International Poultry Welfare Alliance, a founding board member of the US Roundtable for Sustainable Poultry and Eggs, and a past-chair of the Poultry and Egg Welfare and Sustainability Foundation. In 2023, Ken was recognized by the Virginia-Maryland College of Veterinary Medicine as its Lifetime Achievement Alumni Award recipient and in 2024 by the U.S. Poultry and Egg Association as a Lamplighter Award recipient for sustained and exemplary service to the poultry industry.

Robin Patel

Robin Patel, M.D., is the Elizabeth P. and Robert E. Allen Professor of Individualized Medicine and the Director of the Infectious Diseases Research Laboratory, Co-Director of the Clinical Bacteriology Laboratory, Vice Chair of Education in the Department of Laboratory Medicine and Pathology, and former Chair of the Division of Clinical Microbiology, at the Mayo Clinic.

Since the beginning of her tenure at the Mayo Clinic, Dr. Patel has focused her research on bacterial infections. Her work focuses on three major areas: (1) improvement of next-generation diagnostic techniques, (2) understanding the inherent biology of periprosthetic infection, and (3) understanding antibiotic resistance through a clinical lens. She has published over 600 peer-reviewed publications and is supported by the National Institutes of Health and the Centers for Disease Control and Prevention. She is the Director of the Laboratory Center of the Antibacterial Resistance Leadership Group of the National Institutes of Health.

Dr. Patel received an undergraduate degree in Chemistry from Princeton University, where she graduated magna cum laude. From there, she obtained a medical degree from McGill University. Afterwards, Dr. Patel completed Internal Medicine Residency and Fellowships in Medical Microbiology and Infectious Diseases at the Mayo Clinic. Since then, she has been involved in setting standards for diagnostic and clinical care of bacterial infections, as evidenced by the (select) positions she has held or holds within the American Society for Microbiology (President, Secretary), American Board of Pathology (Microbiology Test Writing Committee Member), Clinical and Laboratory Standards Institute (Subcommittee on Antimicrobial Susceptibility Testing Voting Member), National Institutes of Allergy and Infectious Diseases (Council Member), National Board of Medical Examiners (Microbiology/Immunology Test Material Development Committee Chair), Journal of Clinical Microbiology (Associate Editor), Clinical Infectious Diseases

(Associate Editor) and the Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria (Voting Member).

In addition, Dr. Patel's continued commitment to mentorship can be translated into a long list of trainees from around the world; she had dedicated hours of teaching to train the next generation of clinical and research laboratory scientists.

More information can be found at: <https://journals.asm.org/doi/full/10.1128/JCM.01259-20>.

Paul Plummer

Paul J Plummer, D.V.M., Ph.D., DACVIM(LAIM), DECSRHM is Executive Director of NIAMRRE as well as the Associate Dean of Research, Professor and Anderson Endowed Chair in Veterinary Science in Iowa State University College of Veterinary Medicine. His academic role as both a board-certified food animal internal medicine and infectious disease specialist coupled with a PhD in veterinary microbiology, and his leadership of an active research laboratory, place him at the intersection of translational research focused on AMR. In addition, he serves as a Chair and voting member of the Presidential Advisory Council for Combating Antimicrobial Resistant Bacteria (PACCARB) and serves on the American Veterinary Medical Association Committee on Antimicrobials.

Shawn Rangel

Shawn Rangel, M.D., MSCE is a Professor of Pediatric Surgery at Harvard Medical School and currently serves as the Senior Surgical Advisor for Quality & Safety and Weitzman Endowed Chair for Quality & Safety at Boston Children's Hospital. Dr. Rangel's research efforts have largely focused on the study of practice variation in pediatric surgery, and how this variation can be leveraged to improve outcomes and value by identifying and disseminating "best practices" through collaborative models. Dr. Rangel has served as chair of several national efforts with the charge of advancing the agenda of high-quality pediatric surgical care & performance benchmarking, including the American College of Surgeon's (ACS) Children's Surgery Data Steering Committee and Pediatric NSQIP benchmarking program. In this capacity, Dr. Rangel developed and led the ACS's national surgical antimicrobial prophylaxis benchmarking collaborative and developed the antimicrobial stewardship standards for the ACS Children's Surgery Verification program. Dr. Rangel currently serves on the editorial boards of JAMA Pediatrics, Annals of Surgery, and is associate editor for the Journal of Pediatric Surgery and Pediatric Quality & Safety.

Kristin Ray

Kristin Ray, M.D., M.S., is an Associate Professor in the Department of Pediatrics at the University of Pittsburgh. Dr. Ray is a general pediatrician, health services researcher, and clinical informaticist. Her research focuses on improving access, effectiveness, and equity within health care delivery systems, with a focus on the impact of technology on patients and clinicians. She completed her undergraduate degree at Harvard University, medical degree at the University of Pennsylvania, and pediatric residency at the Children's Hospital of Philadelphia. She practiced as a pediatrician with the Indian Health Service before completing a General Academic Pediatrics Research Fellowship at the University of Pittsburgh in 2014. With funding from NIAID and NICHD, her current work includes investigation of parent care-seeking decisions for children with acute respiratory tract infections and antibiotic management for children with acute respiratory tract infections receiving care through telemedicine. Committed to translating research into practice, she serves as Director of Health Systems Improvement for UPMC Children's Community Pediatrics and as Medical Director of Population Health for the Pennsylvania Pediatric Health Network. She

serves as an appointed member of the American Academic of Pediatrics Committee on Pediatric Workforce, and also directs the University of Pittsburgh General Academic Pediatrics Research Fellowship.

Dawn Sievert

Dawn Sievert, Ph.D., M.S., is the Senior Science Advisor and Science Team Lead of the Antimicrobial Resistance Coordination and Strategy Unit in the National Center for Emerging and Zoonotic Infectious Diseases at the Centers for Disease Control and Prevention. She leads strategic direction, coordination, and investments of CDC's cross-cutting scientific antimicrobial resistance (AR) activities and her work ensures that AR projects and collaborations across the agency are appropriate and consistent with CDC scientific vision and priorities. As part of this role, Dr. Sievert provides the scientific leadership for CDC's domestic AR Laboratory Network and Global AR Laboratory & Response Network. She is also Lead of the CDC Collaborating Center within the WHO AMR Network and is a contributing member of the WHO STAG-AMR.

Dr. Sievert has over 20 years of experience working on AR. In her 14+ years at CDC, she previously served as the Associate Director for AR in CDC's Division of Foodborne, Waterborne, and Environmental Diseases and as the Deputy Chief of Surveillance Branch in CDC's Division of Healthcare Quality Promotion, where she provided scientific leadership for CDC's National Healthcare Safety Network. Prior to CDC, Dr. Sievert's work experience includes AR program lead at a U.S. state health department, laboratory researcher and quality improvement/infection control coordinator at two major U.S. healthcare systems, and chief scientist for a consulting company focused on new models of electronic automation and health information exchange in medicine and public health.

Olga Tosas Auguet

Olga Tosas Auguet, Ph.D., is an infectious disease epidemiologist in the Antimicrobial Resistance (AMR) Division, at the World Health Organization/HQ. She was previously senior scientist focusing on AMR research at the Department of Global Health and Tropical Medicine, Nuffield Department of Medicine, University of Oxford, UK. Previously, she was Principal Epidemiologist at the Directorate of Infection of Guy's and St Thomas' NHS Foundation Trust, and at the Clinical Infection and Diagnostics Research Centre—Kings College London, UK. She was also honorary lecturer at the Department of Infectious Diseases, King's College London, UK, and has been consultant epidemiologist for the WHO Global Tuberculosis Programme. She completed her PhD and her post-doctoral research in statistical epidemiology at the Sir Alexander Robertson Centre for Tropical Veterinary Medicine, University of Edinburgh, UK, and at the International livestock research institute, Kenya, as visiting scientist.

John Wingard

John Wingard, M.D., is Professor Emeritus at the University of Florida College of Medicine. He recently retired after serving as Professor of Medicine within the Division of Hematology and Oncology, and Price Eminent Scholar, Director of the Blood and Marrow Transplant and Cellular Therapy Program and Hematologic Malignancy Service. He was also Deputy Director of the UF Health Cancer Center.

Dr. Wingard's research emphases are the conduct of clinical trials to improve outcomes of hematopoietic cell transplant (HCT) and studies of infectious complications and anti-infective strategies in these immunocompromised patients. Dr. Wingard has been continuously NIH-funded since 1999. He has

published more than 450 articles in peer-reviewed journals, more than 60 book chapters, and has edited 4 books. Dr. Wingard has been honored twice by being selected for the University of Florida Research Foundation Professorship, which recognizes faculty members who have distinguished records of research and has won the College of Medicine Faculty Research Prize Clinical Medicine. In each year since 2018, he has been named a Highly Cited Researcher by Clarivate Analytics (top 1% most-cited reports in one's field during the year of publication).

Dr. Wingard has held a number of leadership positions in the field of cellular therapy, including Past Chair of the Advisory Committee of the Center for International Blood and Marrow Transplant Research, past Chair of the Steering Committee of the NHLBI/NCI-sponsored Blood and Marrow Transplant Clinical Trials Network, past member of the Board of Directors of the Foundation for the Accreditation of Cellular Therapies, past President of the American Society of Blood and Marrow Transplantation, and past Chair of the National Marrow Donor Program Board of Directors and current member emeritus.

Suzanne Young

Suzanne Young, PhD, is a technical officer in the Global Coordination and Partnerships department in the AMR Division at the World Health Organization, working with the quadripartite joint secretariat on AMR and supporting the Global Leaders Group on AMR.

Planning Committee Biographies

Jomana Musmar (chair)

Jomana Musmar, Ph.D., M.S., serves as the Designated Federal Officer and Executive Director of the Presidential Advisory Council on Combating Antibiotic Resistant Bacteria--a US federal advisory committee addressing all issues related to AMR through a One Health approach. Dr. Musmar also serves as a Senior Public Health Advisor within the Office of Infectious Diseases and HIV/AIDS Policy. She holds a Masters in Biomedical Science Policy and a Doctorate in Biodefense.

Christopher Braden

Christopher Braden, M.D., serves as the Deputy Director, 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 as 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.

Greg Frank

Greg Frank, Ph.D., is Director, Global Public Policy with Merck, where he leads Merck's global antimicrobial resistance (AMR) and pandemic preparedness policy. Previously Dr. Frank served as Senior Director, Infectious Disease Policy at the Biotechnology Innovation Organization (BIO), where he led several infectious diseases policy issues, including AMR and vaccine regulatory policy. Prior to BIO, Dr. Frank led science and diagnostics policy as Program Officer for Science and Research Policy at the Infectious Diseases Society of America (IDSA).

Dr. Frank serves on the Leadership Council of the National Institute of Antimicrobial Resistant Research and Education (NIAMREE), the expert advisory committee for the Partnership to Fight Infectious Diseases and serves on the Sepsis Alliance Innovation Collaborative. He is a Board member on the AMR Industry

Alliance. Previously, Dr. Frank has served on the U.S. Presidential Advisory Committee on Antibiotic Resistant Bacteria (PACCARB) and joined expert advisory committees of the Access to Medicines Foundation AMR Benchmark, the Global AMR R&D Hub, and the Duke-Margolis Center for Health Policy Antimicrobial Incentives & Payment Reform Project.

Dr. Frank received his doctorate in immunology at the University of Pittsburgh and pursued his postdoctoral training at the Laboratory of Viral Diseases at the National Institute of Allergy & Infectious Diseases.

Elizabeth D. Hermesen

Elizabeth D. Hermesen, Pharm.D., M.B.A., CMD, FIDP, FIDSA is the Senior Medical Director of Launch Excellence at Pfizer and an Adjunct Associate Professor at the University of Nebraska Medical Center, Colleges of Pharmacy and Medicine, in Omaha, Nebraska. Dr. Hermesen received her Doctor of Pharmacy degree from the University of Nebraska Medical Center followed by a pharmacy practice residency at The Nebraska Medical Center, a fellowship in Infectious Diseases Research at the University of Minnesota, College of Pharmacy, and a master's degree in business administration at the University of Minnesota, Carlson School of Management. Following her fellowship, Dr. Hermesen developed and co-directed the antimicrobial stewardship program at The Nebraska Medical Center and then joined Cubist, where she held medical affairs and outcomes research roles and created and led the Antimicrobial Stewardship Outreach Group. Subsequently, Dr. Hermesen transitioned to Merck & Co., Inc. (known as MSD outside the US and Canada), where she was a Global Health Equity Director, responsible for integrating health equity across the enterprise and supporting efforts to improve equitable outcomes, primarily focused on vaccination equity, and the Head of Global Antimicrobial Stewardship, responsible for creating and executing a global strategy to advance antimicrobial stewardship through education, implementation, research, and advocacy, across human, animal, and environmental health. Dr. Hermesen then took on the role of leading Global Antimicrobial Resistance & Antimicrobial Stewardship Medical Affairs at Pfizer, where she was responsible for spearheading the development and implementation of the enterprise global antimicrobial stewardship strategy. Now, in her current role at Pfizer, she is advancing development and implementation of the enterprise launch approach throughout the global medical organization, across all business units and therapeutic areas, with a goal of bringing 25 new products to patients by 2025.

Dr. Hermesen is certified in Medicines Development and is a Fellow of the Society of Infectious Diseases Pharmacists (SIDP) and the Infectious Diseases Society of America (IDSA). She currently serves on the SIDP Policy & Government Affairs Committee, the IDSA Leadership Development Committee, the Scientific Advisory Committee for the Antimicrobial Stewardship Project at the Center for Infectious Diseases Research and Policy, and the Forum on Microbial Threats through the National Academies of Science, Engineering, and Medicine (NASEM). She has contributed to the profession with numerous publications in peer-reviewed journals, book chapters, and by serving as a reviewer for several professional journals. Dr. Hermesen has given over 100 invited presentations at state, regional, national, and international meetings, and she gave a [TED talk](#) regarding antimicrobial resistance and stewardship in 2019.

Ramanan Laxminarayan

Ramanan Laxminarayan, Ph.D., is founder and director of the One Health Trust (formerly the Center for Disease Dynamics, Economics & Policy) in Washington, D.C., and Bangalore, and a senior research scholar at Princeton University. He is an affiliate professor at the University of Washington, senior associate at the Johns Hopkins Bloomberg School of Public Health, and a visiting professor at the National University of Singapore. Laxminarayan chairs the board of GARD-P, a global product development partnership created by the World Health Organization, that aims to develop and deliver new treatments for bacterial infections. He is founder and board chair at HealthCubed, which works to improve access to healthcare

and diagnostics worldwide. Since 1995, Laxminarayan has worked to improve the understanding of antibiotic resistance as a problem of managing a shared global resource. His work encompasses extensive peer-reviewed research, public outreach, and direct engagement across Asia and Africa through the Global Antibiotic Resistance Partnership. Through his prolific research, active public outreach (including a TED talk that has been viewed over a million times) and sustained policy engagement, he has played a central role in bringing the issue of drug resistance to the attention of leaders and policymakers worldwide and to the United Nations General Assembly in September 2016.

Robin Patel

Robin Patel, M.D., is the Elizabeth P. and Robert E. Allen Professor of Individualized Medicine and the Director of the Infectious Diseases Research Laboratory, Co-Director of the Clinical Bacteriology Laboratory, and former Chair of the Division of Clinical Microbiology, at the Mayo Clinic.

Her research focuses on improvement of next-generation diagnostic techniques, understanding the inherent biology of periprosthetic infection, and understanding antibiotic resistance through a clinical lens. She has published over 585 peer-reviewed publications. She is the Director of the Laboratory Center of the Antibacterial Resistance Leadership Group of the National Institutes of Health.

Dr. Patel received an undergraduate degree in Chemistry from Princeton University and a medical degree from McGill University. She completed Internal Medicine Residency and Fellowships in Medical Microbiology and Infectious Diseases at the Mayo Clinic. She has been involved in setting standards for diagnostic and clinical care of bacterial infections, as evidenced by (select) positions she has held or holds within ASM (President), the American Board of Pathology (Test Writing Committee Member), CLSI, National Institutes of Allergy and Infectious Diseases (Council Member), National Board of Medical Examiners (Test Material Committee Chair), Journal of Clinical Microbiology (Associate Editor), and Clinical Infectious Diseases (Associate Editor).

Julia Szymczak

Julia Szymczak, Ph.D., is an Associate Professor in the Division of Epidemiology at the University of Utah School of Medicine, where she Co-Directs the Utah Quality Advancement Laboratory. Dr. Szymczak is a medical sociologist with expertise in the social and cultural determinants of behavior in healthcare organizations. She is an internationally recognized expert on the social dynamics that shape antimicrobial use across clinical contexts in human and veterinary medicine and in the application of implementation science concepts to research in antimicrobial stewardship. Her research has been funded by AHRQ, CDC and PCORI and her peer-reviewed scholarship has appeared in high impact clinical and social science journals. She is the recipient of the 2020 SHEA Research Scholar Award and a Voting Member on the Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria. Dr. Szymczak holds an appointment as an Adjunct Associate Professor of Medicine (Infectious Diseases) at the University of Pennsylvania Perelman School of Medicine and is an Associate Editor of BMJ Quality and Safety. She completed a Postdoctoral Fellowship in the Division of Infectious Diseases at CHOP, holds Ph.D. and M.A. degrees in sociology from the University of Pennsylvania and a B.A. in sociology, summa cum laude, from Brandeis University.

Matthew Zahn

Matthew Zahn, M.D., currently serves as the Deputy Health Officer and the Medical Director for the Communicable Disease Control Division of the Orange County Health Care Agency. He is also Adjunct Professor in the Division of Pediatric Infectious Diseases for the University of California-Irvine Department

of Pediatrics. Dr. Zahn received his doctorate in medicine from St. Louis University School of Medicine and completed his Pediatric Infectious Disease Fellowship at the Children's Hospital of Colorado. From 2004 through 2011, he served as medical director for the Louisville Metro Department of Public Health and Wellness. During that time, he also served as an assistant professor of pediatric infectious disease at the University of Louisville School of Medicine. Since 2008, Dr. Zahn has served on behalf of the National Association of County and City Health Officials as the liaison to the CDC's Advisory Committee of Immunization Practices. From 2017-2018, he was President of the California Association of Communicable Disease Controllers. From 2016-2019, he served as Chair of the Infectious Diseases Society of America's Public Health Workgroup.

Article I. 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.

Article V. 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