Acknowledgments

The fourth edition of *Disease Control Priorities* (*DCP4*) draws on the global health knowledge of institutions and experts from around the world, including volume editors, chapter authors, peer reviewers, and research and staff assistants. The finalization of this second volume would not have been possible without the intellectual vision, enduring support, and invaluable contributions of these individuals.

We owe gratitude to the financial sponsors of this effort. We are indebted to the Gates Foundation for supporting and funding the DCP Country Translation projects that helped us stake out the direction for future work in DCP4. We acknowledge the Research Council of Norway that—through its Centre of Excellence grant to the Bergen Centre for Ethics and Priority Setting in Health (BCEPS) at the University of Bergen—has enabled us to set up and develop a core analytics team for evidence collection, mathematical modeling, and economic evaluations. A special thank you goes to the Norwegian Agency for Development Cooperation (Norad) and the Trond Mohn Foundation, which have co-funded much of the ongoing country engagement work, including local capacity strengthening and master's and PhD training in health economics, ethics, and priority setting.

We are grateful to the University of Bergen, the Department of Global Public Health and Primary Care, and BCEPS for supporting the training of numerous students and creating a home base for the DCP4 Secretariat, a base that provides intellectual collaboration, logistical coordination, and administrative and social support. We thank those who worked behind the scenes within the department to ensure this work ran smoothly, including Wafa Aftab, Austen Davis, Øystein Ariansen Haaland, Kjell Arne Johanson, Solomon Memirie, Omar Mwalim, Jan-Magnus Økland, Bjarne Robberstad, Guri Rørtveit, Ingvild Sandøy, Maria Sollohub, and Jana Wilbricht.

The World Bank provided exceptional guidance and support throughout the planning phase, the review process, and the demanding production and design process. Within the World Bank, we especially thank Jung-Hwan Choi, Victoria Y. Fan, Magnus Lindelow, Martin Mpungu Lutalo, Juan Pablo Uribe, Monique Vledder, and Feng Zhao who served as champions of DCP4; and we thank the numerous expert reviewers of all chapters (refer to the list of reviewers). Mary Fisk oversaw the editing and publication of the series with diligence and expertise, and we are pleased to have had designer Debra Naylor, who developed the beautiful and crisp design for this volume and the series as a whole. Additionally, we thank Acquisitions Editor Jewel McFadden of World Bank publications for providing professional counsel on contracts, communications, and marketing strategies.

Volume and Series Editors

VOLUME EDITORS

Stefano M. Bertozzi

Stefano M. Bertozzi is former dean and professor of health policy at the University of California, Berkeley School of Public Health. He previously led HIV and tuberculosis programs at the Gates Foundation and directed Mexico's Instituto Nacional de Salud Pública (INSP) Center for Evaluation Research. He was the last director of the World Health Organization's Global Programme on AIDS and has worked with the Joint United Nations Programme on HIV/AIDS, the World Bank, and the government of the Democratic Republic of Congo.

He is founding editor in chief of *Rapid Reviews\Infectious Diseases*. A member of the National Academy of Medicine, Dr. Bertozzi holds a biology degree and a PhD in health policy from the Massachusetts Institute of Technology (MIT); he earned his MD at the University of California, San Diego, and trained in internal medicine at the University of California, San Francisco.

Victoria Y. Fan

Victoria Y. Fan is a senior economist in health financing at the World Bank. She previously served at the Center for Global Development from 2022–24 and 2011–14. From 2014 to 2024, she was faculty at the University of Hawaii, including tenured associate professor and interim director of the Center on Aging. At the University of Hawaii, she founded the Pacific Health Analytics Collaborative, a laboratory with more than 120 employees that conducted policy research on social determinants of health and mental health. During the COVID-19 (coronavirus) pandemic, she established and chaired the Hawaii Pandemic Applied Modeling working group advising state leaders and served as executive director of Hawaii CARES, the state's integrated call center and managed care network for mental health and substance use. She has more than 200 publications, including 70 articles in peer-reviewed journals. She holds a doctorate in health systems from Harvard University and a bachelor's in mechanical engineering from MIT. She was born and raised in Hawaii.

Dean T. Jamison

Dean T. Jamison is professor emeritus of health economics at the University of California, San Francisco. He has worked at the World Bank as manager of both its education policy division and its health, nutrition, and population division. His subsequent career was in academia, including eight years as director of UCLA's Center for Pacific Rim Studies. At the World Bank, he initiated the *Disease Control Priorities* series. Jamison studied at Stanford University and at Harvard University, where he received his PhD in economics under Kenneth Arrow. He is a member of the Academy of Medicine of the US National Academies of Science, Engineering, and Medicine.

Hitoshi Oshitani

Hitoshi Oshitani is a professor for the Department of Virology at Tohoku University Graduate School of Medicine in Japan. Before joining Tohoku University, he was a regional adviser of the World Health Organization Western Pacific Regional Office in Manila from 1999 to 2005, where he was responsible for emerging diseases, including severe acute respiratory syndrome and avian and pandemic influenza. He worked as a technical expert for Japan International Cooperation in Zambia from 1991 to 1994. His main research interest is epidemiology and control of viral infections, particularly respiratory viruses such as influenza and respiratory syncytial viruses. His research group has been conducting research in Japan and other countries such as Mongolia, the Philippines, and Zambia. He was a member of the Advisory Board and the Subcommittee on COVID-19 for the government of Japan during the COVID-19 pandemic. He is also a member of the Strategic and Technical Advisory Group on Infectious Hazards with Pandemic and Epidemic Potential, and other technical groups of the World Health Organization.

Siddhanth Sharma

Dr. Siddhanth Sharma is a public health physician at the Burnet Institute in Australia, where he leads research on developing and evaluating interventions to improve indoor air quality. Before joining Burnet, Dr. Sharma contributed to communicable disease control efforts and supported environmental health projects for the Western Australian Department of Health, including work on climate change and outdoor air quality. He holds a masters of public health degree from Harvard University and a medical degree from the University of Notre Dame Australia.

Muhammad Ali Pate

Muhammad Ali Pate serves as Nigeria's coordinating Minister of Health and Social Welfare. He formerly served as the global director of the Health, Nutrition and Population Global Practice at the World Bank and was Julio Frenk Professor of the Practice of Public Health Leadership in the Department of Global Health and Population at the Harvard T. H. Chan School of Public Health.

Dr. Pate is an MD trained in both internal medicine and infectious diseases, with an MBA from Duke University. Previously, he studied at the University College London. He also holds a master's in health system management from the London School of Hygiene and Tropical Medicine.

Ole F. Norheim

Ole F. Norheim is a physician and Mary B. Saltonstall Professor of Ethics and Population Health at the Department of Global Health and Population, Harvard T. H. Chan School of Public Health. He co-founded the Bergen Centre for Ethics and Priority Setting in Health at the University of Bergen, Norway, and is an adjunct researcher at the center.

His research interests include theories of distributive justice, inequality in health, priority setting in health systems, and how to achieve universal health coverage in low- and middle-income countries. He is the lead series editor of *Disease Control Priorities* (fourth edition) and a member of the *Lancet* Commission on Investing in Health and the *Lancet* Commission on Sustainable Healthcare. Dr. Norheim is an elected member of the Norwegian Academy of Science and Letters. He has served as head of the Norwegian Biotechnology Advisory Board (2019–23), as chair of the World Health Organization's Consultative Group on Equity and Universal Health Coverage (2012–14), and on the third Norwegian National Committee on Priority Setting in Health Care (2013–14).

SERIES EDITORS

Ole F. Norheim

Refer to the list of volume editors.

David A. Watkins

David A. Watkins is an associate professor in the Division of General Internal Medicine and in the Department of Global Health at the University of Washington. He currently leads the University of Washington site for the Disease Control Priorities Project and is affiliated with the Implementation Science Program in the Department of Global Health. Additionally, he is the co-director of the Learning for Action in Policy Implementation and Health Systems initiative. He studies health system reform and policy challenges, with a particular emphasis on universal health coverage and the growing burden of noncommunicable diseases in low-income countries. His team works in three thematic areas: (1) population and economic modeling to support policy analysis, (2) integrated health care delivery, and (3) use of evidence in policy formulation. In addition to his scholarly work, Dr. Watkins teaches global noncommunicable diseases and quantitative research methods and practices as a hospitalist at Harborview Medical Center.

Kalipso Chalkidou

Kalipso Chalkidou is the director of the Department of Health Financing and Economics at the World Health Organization headquarters. Before that, she founded and ran the Department of Health Finance at the Global Fund to Fight AIDS, Tuberculosis and Malaria. She also served as director of global health policy and was a senior fellow at the Center for Global Development. She is a visiting professor of global health at the School of Public Health, Imperial College London.

Her past work has concentrated on helping governments build technical and institutional capacity for using evidence to inform health policy as they move toward universal health coverage. She is interested in how local information, local expertise, and local institutions can drive scientific and legitimate health care resource allocation decisions. She has been involved in the Chinese rural health reforms and in national health reform projects in Colombia, Ghana, India, South Africa, Türkiye, and the Middle East, working with the Inter-American Development Bank; the Pan American Health Organization; the UK Foreign, Commonwealth & Development Office; and the World Bank, as well as national governments.

Victoria Y. Fan

Refer to the list of volume editors.

Muhammad Ali Pate

Refer to the list of volume editors.

Dean T. Jamison

Refer to the list of volume editors.

Contributors

Olaolu M. Aderinola

 Emergency Preparedness and Response Cluster, WHO Regional Office for Africa, Brazzaville, Republic of Congo

Puspanjali Adhikari

• Kathmandu University, Nepal

David Agus

• Ellison Medical Institute, Los Angeles, California, United States

Megan Akodu

• Ellison Institute of Technology, Oxford, United Kingdom

Ahmad Al-Kasir

• Ellison Medical Institute, Los Angeles, California, United States

Patrick Amoth

• Ministry of Health, Kenya

Brett N. Archer

 Health Emergencies Programme, World Health Organization, Geneva, Switzerland

Rinette Badker

• Ginkgo Bioworks, Emeryville, California, United States

Valentina Baltag

• World Health Organization, Geneva, Switzerland

Till Bärnighausen

· Heidelberg Institute of Global Health, Germany

Biniam Bedasso

· Center for Global Development, Washington, DC, United States

John Bell

• Ellison Institute of Technology, Oxford, United Kingdom

Kirsten Bell

• Ellison Institute of Technology, Oxford, United Kingdom

Tamsin Berry

• Ellison Institute of Technology, Oxford, United Kingdom

Franck Berthe

• World Bank, Washington, DC, United States

Stefano M. Bertozzi

• University of California, Berkeley, California, United States

David E. Bloom

 Harvard T. H. Chan School of Public Health, Boston, Massachusetts, United States

Donald A. P. Bundy

• London School of Hygiene and Tropical Medicine, United Kingdom

Carmen Burbano

• World Food Programme, Rome, Italy

David Canning

 Harvard T. H. Chan School of Public Health, Boston, Massachusetts, United States

Bin Cao

· Capital Medical University, Beijing, China

Lúcia Chambal

• Maputo Central Hospital, Maputo, Mozambique

Catherine Che

 Department of Economics, University of California, Berkeley, California, United States

Simiao Chen

• University of Heidelberg, Germany

Wenjin Chen

· University of Heidelberg, Germany

Sarrin Chethik

• Market Shaping Accelerator, University of Chicago, Illinois, United States

Matchecane Cossa

• Maputo Central Hospital, Maputo, Mozambique

Greta Davis

• University of California, San Francisco, California, United States

Olivier le Polain de Waroux

 Health Emergencies Programme, World Health Organization, Geneva, Switzerland

W. John Edmunds

• London School of Hygiene and Tropical Medicine, United Kingdom

Victoria Y. Fan

 World Bank, Washington, DC; formerly Center for Global Development, Washington, DC, United States

Maddalena Ferranna

• University of Southern California, Los Angeles, California, United States

Jane Fieldhouse

• University of California, Davis, California; formerly University of California, San Francisco, California, United States

Ugo Gentilini

• World Bank, Washington, DC, United States

Rachel Glennerster

• Department of Economics, University of Chicago, United States

Tracey Goldstein

 Colorado State University (contributed while at United States Agency for International Development), United States

Kumeren Govender

• Ellison Institute of Technology, Oxford, United Kingdom

Lee M. Hampton

• US Centers for Disease Control and Prevention, Atlanta, Georgia, United States

Eric Hanushek

• Stanford University, Stanford, California, United States

Ines Hassan

• Ellison Institute of Technology, Oxford, United Kingdom

Karli Tyance Hassell

• Central Council of the Tlingit and Haida Indian Tribes of Alaska

Sean Hillier

· York University, Toronto, Canada

Chikwe Ihekweazu

 Health Emergencies Programme, World Health Organization, Geneva, Switzerland; World Health Organization Hub for Pandemic and Epidemic Intelligence, Berlin, Germany

Dean T. Jamison

• University of California, San Francisco, California, United States

Julian Jamison

• Universities of Oxford and Exeter, United Kingdom

Lirui Jiao

• University of North Carolina, United States

Sun Kim

 Harvard T. H. Chan School of Public Health, Boston, Massachusetts, United States

Rassin Lababidi

• Chatham House, London, United Kingdom

Cathine Lam

• Ginkgo Bioworks, Emeryville, California, United States

Christopher T. Lee

• Resolve to Save Lives, New York, United States

Greg Lewis

• Future of Humanity Institute, University of Oxford, United Kingdom

Henry Li

• Tony Blair Institute for Global Change, London, United Kingdom

Gabriel Assis Lopes do Carmo

• Federal University of Minas Gerais, Brazil

Catherine Machalaba

• The Nature Conservancy, United States; formerly EcoHealth Alliance

Nita K. Madhav

• Ginkgo Bioworks, Emeryville, California, United States

Sri Harshavardhan Malapati

• Harvard University, Boston, Massachusetts, United States

Romina Mariano

• Africa Clinical Research Network, Harare, Zimbabwe

Jonna Mazet

• University of California, Davis, California, United States

Claire T. McMahon

• Market Shaping Accelerator, University of Chicago, Illinois, United States

Amanda Meadows

• Ginkgo Bioworks, Emeryville, California, United States

Elizabeth Mumford

• University of Surrey, United Kingdom

Ole F. Norheim

 Harvard T. H. Chan School of Public Health, Boston, Massachusetts, United States

Ben Oppenheim

• Ginkgo Bioworks, Emeryville, California; Center for Global Development, Washington, DC, United States

Hitoshi Oshitani

Tohoku University, Japan

Geoffrey Otim

• SynBio Africa, Makerere University, Kampala, Uganda

Qian Yi Pang

• Ellison Institute of Technology, Oxford, United Kingdom

Muhammad Ali Pate

• Ministry of Health and Social Welfare of Nigeria

Edith Patouillard

• World Health Organization, Geneva, Switzerland

Sharmila Paul

• University of California, San Francisco, California, United States

Alexandra Penn

 University of Sussex, United Kingdom; formerly University of Surrey, United Kingdom

Govind Persad

• University of Denver, Colorado, United States

Diego Pineda

• University of California, Berkeley, California, United States

Nistara Randhawa

• University of California, Davis, California, United States

John Rose

• University of California, San Francisco, California, United States

Sophie Rose

• Centre for Long-Term Resilience, London, United Kingdom

Jonathan Rushton

• University of Liverpool, United Kingdom

Linda Schultz

• London School of Hygiene and Tropical Medicine, United Kingdom

Gabriel Seidman

• Ellison Institute of Technology, Oxford, United Kingdom

Siddhanth Sharma

• Burnet Institute, Melbourne, Australia

Zara Shubber

• World Bank, Washington, DC, United States

Christopher M. Snyder

 Department of Economics, Dartmouth College, Hanover, New Hampshire, United States

Emily Stanger-Sfeile

• Tony Blair Institute for Global Change, London, United Kingdom

Cristina Stefan

• Centre for Disaster Protection, London, United Kingdom

Nicole Stephenson

• Ginkgo Bioworks, Emeryville, California, United States

Anna-Maria Tammi

• Global Partnership for Education, Washington, DC, United States

Dipesh Tamrakar

• Kathmandu University, Nepal

Eri Togami

• Johns Hopkins University, Baltimore, Maryland, United States

Helene-Mari van der Westhuizen

• University of Oxford, United Kingdom

Sabine L. van Elsland

 MRC Centre for Global Infectious Disease Analysis, Imperial College London, United Kingdom

Supaporn Wacharapluesadee

 Thai Red Cross Emerging Infectious Diseases Clinical Center, King Chulalongkorn Memorial Hospital, Chulalongkorn University, Thailand

Chen Wang

· Chinese Academy of Medical Sciences, Beijing, China

Darcy Ward

• Tony Blair Institute for Global Change, London, United Kingdom

Kathleen Warren

 Health Emergencies Programme, World Health Organization, Geneva, Switzerland

David A. Watkins

• University of Washington, Seattle, Washington, United States

Charles Whittaker

 MRC Centre for Global Infectious Disease Analysis, Imperial College London, United Kingdom; Division of Infectious Diseases and Vaccinology, School of Public Health, University of California, Berkeley, California, United States

Bridget Williams

• Uehiro Centre for Practical Ethics, University of Oxford, United Kingdom

Jiuyang Xu

• China-Japan Friendship Hospital, Beijing, China

Lan Xue

• Tsinghua University, Beijing, China

Jakob Zinsstag

• Swiss Tropical and Public Health Institute, Allschwil, Switzerland

Reviewers

Shuchi Anand

• Stanford University, Stanford, California, United States

Sulzhan Bali

• World Bank, Washington, DC, United States

Stefano M. Bertozzi

• University of California, Berkeley, California, United States

Mark Blecher

• National Treasury, South Africa

Mukesh Chawla

• World Bank, Washington, DC, United States

Nejma Cheikh

• World Bank, Washington, DC, United States

Alex Cook

• National University of Singapore, Singapore

Benjamin Cowling

• University of Hong Kong, Hong Kong SAR, China

Nir Eyal

• Rutgers University, New Brunswick, New Jersey, United States

Clementine Fu

• World Bank, Washington, DC, United States

Ramesh Govindaraj

• World Bank, Washington, DC, United States

Moytrayee Guha

• World Bank, Washington, DC, United States

Nilofer Habibullah

• World Bank, Washington, DC, United States

Katharina Hauck

• Imperial College London, United Kingdom

Kathryn Jacobsen

• University of Richmond, Richmond, Virginia, United States

Dean T. Jamison

• University of California, San Francisco, California, United States

Magnus Lindelow

• World Bank, Washington, DC, United States

Joe Millum

· University of St. Andrews, Scotland

Linda Mobula

• World Bank, Washington, DC, United States

Suresh Kunhi Mohammed

• World Bank, Washington, DC, United States

Son Nam Nguyen

• World Bank, Washington, DC, United States

Ole F. Norheim

 Harvard T. H. Chan School of Public Health, Boston, Massachusetts, United States; University of Bergen, Norway

Ben Oppenheim

 Ginkgo Bioworks, Emeryville, California, United States; Center for Global Development, Washington, DC, United States

Hitoshi Oshitani

• Tohoku University, Japan

Joao Pires

• World Bank, Washington, DC, United States

Siddhanth Sharma

• Burnet Institute, Melbourne, Australia

Woutrina Smith

• University of California, Davis, California, United States

Karin Stenberg

• World Health Organization, Geneva, Switzerland

Jonathan Suk

• European Centre for Disease Prevention and Control, Solna, Sweden

Jeremy Veillard

• World Bank, Washington, DC, United States

Saul Walker

• Foreign, Commonwealth & Development Office, London, United Kingdom

David A. Watkins

• University of Washington, Seattle, Washington, United States

Martin Weber

• World Health Organization Regional Office for Europe, Copenhagen, Denmark

Paul Wilson

• Columbia University, New York, United States