VOLUME 2

DISEASE CONTROL PRIORITIES • FOURTH EDITION

Investing in Pandemic Prevention, Preparedness, and Response

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Disease Control Priorities

This fourth edition of *Disease Control Priorities* (*DCP4*) builds on the first three editions, all published by the World Bank. Through collaboration and capacity strengthening in a select number of low- and middle-income countries, *DCP4* summarizes, produces, and helps translate economic evidence into better priority setting for universal health coverage, public health functions, pandemic preparedness and response, and intersectoral and international action for health. *DCP4* aims to be relevant for countries committed to increasing public financing of universal health coverage and other health-improving policies, recognizing the need to set priorities on those countries' path to achieving the Sustainable Development Goals and beyond. The project is a collaboration between the World Bank and the University of Bergen, Norway, to develop and co-publish *DCP4* in four volumes with broad inputs from individuals and institutions around the world. These plans will likely evolve in the course of the work.

More people live longer and have better lives today compared to any other time in history. The world's population is aging at a dramatic speed. Improved living standards and new technologies are driving this change. However, we live in times of increased risks. No country can afford all technologies that are effective at improving health and well-being—and progress is unequal. The COVID-19 (coronavirus) pandemic has emphasized the vulnerability of countries when a threatening new infection affects life, the health system, work, and the economy. Climate change is another major challenge. Those already worse off are especially affected, by both direct and indirect effects on the health system, the economy, and the environment. During times of crisis, health care providers and policy makers must decide whom to prioritize and which programs to protect, expand, contract, or terminate.

These challenges are not unique to pandemics and climate change. Resource allocation decisions under scarcity are always being made, creating winners and losers when compared to the status quo. Such decisions may exacerbate or ameliorate existing inequities, which are often substantial. These risks are not the only reminders of the importance and urgency of priority setting in global health; in

many low-income countries, the unfinished agenda with respect to infections and maternal and child mortality competes with increasing needs to prevent and treat chronic conditions such as cardiovascular diseases, cancer, and mental health. How should countries prioritize among infectious diseases, maternal and child health programs, and prevention of noncommunicable diseases? How should a health ministry define essential health benefit packages to be financed under universal health coverage reforms? Priority setting is key, and we now have the experience and the tools needed to improve and implement decision support for more efficient and fair resource allocation on the path to better health and well-being for all.

Disease Control Priorities provides a periodic review of the most up-to-date evidence on cost-effective and equitable interventions to address the burden of disease in low-resource settings. The third edition (*DCP3*), published by the World Bank Group, included nine volumes laying out a total of 21 essential universal health coverage packages and 71 intersectoral policies. Each essential package addressed the concerns of a major professional community and contained a mix of intersectoral policies and health sector interventions. Since then, several countries have used this evidence and translated it into revised health system priorities. In many countries, experts from the World Health Organization and the World Bank have been substantially involved. Key results have been published in a series of high-impact journal articles. *DCP3* relied primarily on cost-effectiveness analysis to evaluate interventions, using benefit-cost analysis in some cases to address the overall impacts on social welfare. It also introduced a new extended cost-effectiveness analysis method to account for the equity and financial protection impacts of extending coverage of proven effective interventions. *DCP4* builds on these methods but differs substantially from its predecessors by adopting a country-led approach to priority setting.

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Contents

Foreword by The Right Honourable Helen Clark

When public notification was provided for a pneumonia of unknown origin in the last days of 2019, some governments took notice and action, but life continued as usual in most countries. The World Health Organization's (WHO) declaration of a public health emergency of international concern (PHEIC) on January 30, 2020—the highest level of global public health alert at the time—failed to prompt meaningful action in many national capitals.

It was not until March 11, when the WHO Director-General characterized COVID-19 as a pandemic, that the gravity of the situation began to penetrate the halls of power. Apathy gave way to fear and panic. As the virus spread across borders with alarming speed, people began to ask: How could COVID-19 cause so much destruction so quickly?

At The Independent Panel for Pandemic Preparedness & Response—which I co-chair with President Ellen Johnson Sirleaf—we were determined to help answer that question. Our task, requested by the World Health Assembly, was clear: to examine the global response to COVID-19; identify the strengths, gaps, and failures; and provide actionable recommendations for the future. In May 2021, we presented our evidence-based package of proposals to the World Health Assembly. Our goal was to ensure that COVID-19 would be the last pandemic of such devastation. Our recommendations were urgent, ambitious, and practical.

We called for transformative change in several areas: highest-level political leadership; financing for pandemic prevention, preparedness, and response (PPPR) as a global common good; a strong and independent WHO; a modern and rapid system for surveillance and alert; equitable access to medical countermeasures; and accountability.

Since 2021, there have been areas of progress. WHO Member States have adopted amendments to the International Health Regulations. In May 2025, the World Health Assembly adopted a landmark Pandemic Agreement that provides a new

framework for collective international action. The Pandemic Fund, launched in 2021, has raised much-needed financing for preparedness for low- and middle-income countries. An innovative mRNA technology transfer programme—engaging 15 middle-income countries—is helping to build scientific capacity and a geo-diversified research and development ecosystem.

Although these are important steps, we must be clear: progress has been neither fast enough nor far-reaching enough. If a novel pathogen were to emerge today, it would still find dangerous gaps in our systems that could allow an outbreak to escalate into a pandemic and prevent a rapid, equitable response if the worst were to occur.

Preparedness and response financing remains vastly insufficient and overly reliant on development assistance, which is itself now in grave jeopardy. Many countries and communities still lack access to the tools, systems, and resources they need to detect outbreaks early and respond effectively. Gaps in risk and readiness monitoring leave the world blind to emerging threats.

The recent responses to outbreaks of mpox and avian influenza A (H5N1) serve as sobering reminders of these shortcomings. The H5N1 response has exposed tensions between human and animal health sectors. The mpox response has seen reactive and delayed funding and a continued reliance on charitable models that leave low- and middle-income countries dependent on the goodwill of others. The development and stockpiling of medical countermeasures remains largely concentrated in high-income countries, and One Health approaches—essential to tackling zoonotic threats—are still not meaningfully integrated across sectors.

Despite these challenges, I remain optimistic. Of all the complex global problems that we face today, preventing a new pandemic is one we know how to address.

This important new collection brings together evidence and lessons from COVID-19 that can support policy makers in preparing better and in taking effective measures against new threats. The evidence-based discussion of a range of issues in these pages—including future mortality estimates, Always On systems, outbreak detection, public health measures, acute care, and financing—provides evidence upon which we can act.

The question is not whether we can do it, but whether we choose to do it. It is a matter of political will and collective action. Leaders must see pandemic prevention, preparedness, and response as core elements of a resilient, secure, and just world.

COVID-19 showed, in the starkest possible terms, that pandemic preparedness is not a theoretical or technocratic exercise. It is about lives, livelihoods, and the bonds of trust that hold societies together.

A new pandemic threat will emerge, and it will test us all again. Presidents, Prime Ministers, Ministers of Health and Finance—all leaders at every level—must recognize the responsibility they share. They have the lessons and the evidence to act now to prepare and respond. Not to learn from those lessons and act on that evidence puts us all at great risk. A virtue of this volume is that it provides options for any government with the foresight to address that risk.

Helen Clark
Co-Chair of The Independent Panel for Pandemic
Preparedness & Response;
Former Prime Minister of New Zealand;
Former Administrator of the United Nations
Development Programme

Foreword by Gabriel M. Leung

The vocative title of this latest volume of the Disease Control Priorities project is spot-on: resourcing pandemic prevention, preparedness, and response is very much an "investment"—or at least insurance—as opposed to an expense. It yields one of the best health and economic impact returns, not least to reduce potential attributable lives (and livelihoods) lost, as chapter 2 attests. Every post hoc evaluation of past pandemics or consensus report to better prepare the world for the next global outbreak presents reinforcing empirical evidence. The case is indisputable.

Despite decades of recent experience—from influenza to severe acute respiratory syndrome (SARS), Ebola to mpox, and most recently COVID-19—gaps remain, particularly in implementing difficult but vital changes in the way governments prepare and respond. Some of these lacunae have remained unaddressed from epidemic to epidemic, whereas others arise from dynamic new developments in external circumstances. Chapter 3 on One Health presents an example of the former. Effective realization of this concept requires a whole-of-society approach, across all countries, to fundamentally redress frailties in animal husbandry and environmental degradation, reflecting recognition of their causative role in the generation and recrudescence of the zoonotic origins of many public health emergencies of international concern. The authors of chapter 1, echoing the 78th World Health Assembly that adopted the Pandemic Agreement by consensus, put the primary responsibility for this work squarely on the shoulders of countries and local authorities, albeit with external assistance as appropriate.

On how broader external changes can improve outbreak control, chapters 6 through 8 describe anti-epidemic measures that trace their first deployment to the fourteenth century. The very term "quarantine" descends from "quarantino" ("40 days" in old Italian)—the duration of holding incoming ships anchored off the Adriatic port of Ragusa to keep the bubonic plague at bay. These chapters illustrate how modern innovations have revolutionized what is now possible, for instance, the effectiveness of total lockdown of societal functions until vaccines became available during

COVID-19. In China, the powerful combination of "neighborhood committees" on the ground enforcing home quarantine, the conversion of community halls and sports stadiums to Fangcang shelter hospitals for isolation, and the ubiquitous use of the "super app" WeChat enabled the longest and most robust cordon sanitaire in history. Although sickness records of English boarding schools and the rotating term times of French schools by region have long established closures as an effective transmission-limiting measure, the prolonged nature of such closures during the COVID-19 pandemic tested the optimality between disease control and child development to the limit.

Chapters 9 and 10 remind us of the transformative role of vaccination, accelerated and empowered by the latest scientific breakthroughs on a timescale hitherto unseen, but increasingly threatened by populist "infodemics" and still made inaccessible to the most socially and medically needy through perpetuation of preexisting inequities. Unless and until satisfactory agreement is reached on the vexed annex of the Pandemic Agreement—the so-called product access and benefit sharing system—this Achilles' heel of global health security will remain so.

Whereas Chapter 11 gives us a reassuring glimpse of a future of Always On surveillance and early warning, the subsequent three chapters offer a sobering reminder of the critical turnkey of just-in-time and judicious financing. That financing must be guided by a nonpartisan and compassionate ethical compass to a world better protected from infectious perils is discussed in chapter 15.

Finally, hard science and rational policy often cannot overcome the realpolitik between and within countries. The recent upswing in nationalist populism across multiple countries and the corollary of wholesale diversion of overseas development aid to buttress defense budgets have shaken the global health architecture to its core. Ironically, those that built this system are particularly responsible for the demise of global health 1.0. Whether and how a 2.0 version will pan out—perhaps via a shifting and more transactional coupling of regional or otherwise like-minded sets of sovereign and philanthropic actors—remains uncertain.

That is precisely why the present volume is such a timely and valuable contribution of reasoned thinking to guide us through these interesting times. When making decisions, those in positions of authority who are entrusted to rebuild and reinforce our prevention, preparedness, and response system would do well to reflect on the chapters herein.

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Abbreviations

AAL	average annual loss
ACER	average cost-effectiveness ratio
ADB	Asian Development Bank
AfDB	African Development Bank
AI	artificial intelligence
AMC	advance market commitment
AMR	antimicrobial resistance
ARDS	acute respiratory distress syndrome
AVMA	African Vaccine Manufacturing Accelerator
BCEPS	Bergen Centre for Ethics and Priority Setting in Health
BRICS	Brazil, Russian Federation, India, China, and South Africa
BSE	bovine spongiform encephalitis
BSL1	biosafety level 1
BSL2	biosafety level 2
BSL3	biosafety level 3
BSL3+	biosafety level 3+
BSL4	biosafety level 4
C19RM	COVID-19 Response Mechanism
CAT DDO	Catastrophic Deferred Drawdown Option
CCRT	Catastrophe Containment and Relief Trust
CEP	cumulative exceedance probability
CEPI	Coalition for Epidemic Preparedness Innovations
CERC	Contingency Emergency Response Component
CERF	Central Emergency Response Fund
CFE	Contingency Fund for Emergencies
CFR	case fatality ratio
CHI	controlled human infection

CHR	case hospitalization ratio
CI	confidence interval
C-MHI-MFI	combined mandatory home- and facility-based isolation
COPD	chronic obstructive pulmonary disease
COVAX	COVID-19 Vaccines Global Access
COVID-19	coronavirus disease 2019
CPRO	COVID-19 Pandemic Response Option
CRW	Crisis Response Window
CSF	Countercyclical Support Facility
CT	computed tomography
C-VHI-VFI	combined voluntary home- and facility-based isolation
DALY	disability-adjusted life year
DCP	Disease Control Priorities
DCP3	*Disease Control Priorities, Third Edition*
DCP4	*Disease Control Priorities, Fourth Edition*
DPL	Development Policy Loan
DURC	dual-use research of concern
EBRD	European Bank for Reconstruction and Development
ECF	Extended Fund & Credit Facility
ECMO	extracorporeal membrane oxygenation
ECSC	emergency, critical, and surgical care
EDCTP2	European & Developing Countries Clinical Trials Partnership, Second Programme (2014–24)
EKG	electrocardiogram
EP	exceedance probability
EPF	exceedance probability function
EPI	Expanded Programme on Immunization
EVD	Ebola virus disease
FAO	Food and Agricultural Organization of the United Nations
FMD	foot and mouth disease
FOI	force of infection
Gavi	Gavi, the Vaccine Alliance
GDP	gross domestic product
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
GHI	global health initiative
GHSI	Global Health Security Index
GNI	gross national income
H1N1	swine flu
HEPR	health emergency prevention, preparedness, response, and resilience
HIC	high-income country

HIV	human immunodeficiency virus
HIV/AIDS	human immunodeficiency virus and acquired immune deficiency syndrome
IBRD	International Bank for Reconstruction and Development
ICER	incremental cost-effectiveness ratio
ICU	intensive care unit
IDA	International Development Association
IDB	Inter-American Development Bank
IDSR	Integrated Disease Surveillance and Response
IFFIm	International Finance Facility for Immunisation
IHR	International Health Regulations
IM	intramuscular
IMF	International Monetary Fund
IP	intellectual property
IPF	Investment Project Financing
IRM	Immediate Response Mechanism
IsDB	Islamic Development Bank
ISO	International Organization for Standardization
IV	intravenous
JEE	Joint External Evaluation
LAI	laboratory-acquired infection
LIC	low-income country
LMICs	low- and middle-income countries
MCER	marginal cost-effectiveness ratio
MDB	multilateral development bank
MERS	Middle East respiratory syndrome
MFI	mandatory facility-based isolation
MHI	mandatory home-based isolation
MIC	middle-income country
ML	machine learning
MPA	Multiphase Programmatic Approach
MRI	magnetic resonance imaging
Norad	Norwegian Agency for Development Cooperation
OCR	Ordinary Capital Resources
ODA	official development assistance
ODF	official development finance
OIE	Office International des Epizooties
OOF	other official flows
OT	occupational therapy
P&P	prevention and preparedness
PAHO	Pan American Health Organization

PEF	Pandemic Emergency Financing Facility
PEP	post-exposure prophylaxis
PforR	Program-for-Results
PHEIC	public health emergency of international concern
PHSM	public health and social measures
PISA	Programme for International Student Assessment
POC	point of care
PPE	personal protective equipment
PPP	purchasing power parity
PT	physical therapy
QALY	quality-adjusted life year
R	South African rand
R&D	research and development
RR	reporting ratio
RSF	Resilience and Sustainability Facility
SARI	severe acute respiratory infection
SARS	severe acute respiratory syndrome
SEIHR	Susceptible–Exposed–Infectious–Hospitalized–Recovered
SLP	speech language pathology
SMC	School Meals Coalition
TB	tuberculosis
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
UHC	Universal Health Coverage
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNEP	United Nations Environment Programme
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UV	ultraviolet
VFI	voluntary facility-based isolation
VHF	viral hemorrhagic fever
VHI	voluntary home-based isolation
VOC	variant of concern
VSL	value per statistical life
VxRate	vaccination rate
VxEff	vaccination efficacy
WB_IBRD	World Bank, International Bank for Reconstruction and Development

WB_IDA	World Bank, International Development Association
WHO	World Health Organization
WOAH	World Organisation for Animal Health (founded in 1924 as Office International des Epizooties [OIE])
WPV3	wild poliovirus type 3