IMPROVING GLOBAL HEALTH: FORECASTING THE NEXT 50 YEARS

PATTERNS OF POTENTIAL HUMAN PROGRESS

VOLUME 3

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Cover Art
The cover art is a representation of an oil painting by Margaret Lawless, artist for the PPHP series. Ms. Lawless is a contemporary abstract artist whose works in various media portray aspects of the human condition, human progress, and the interaction of humans with nature. In this particular painting, she emphasizes the potential inherent within all human beings to experience the full life cycle that health and a healthy environment enable. The S-curve suggested by the red band represents global transitions in health and life expectancy, the further improvement of which is the focus of this volume.

IMPROVING GLOBAL HEALTH:
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PATTERNS OF POTENTIAL HUMAN PROGRESS

VOLUME 3

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Preface

***Improving Global Health: Forecasting the Next 50 Years* is third in the Patterns of Potential Human Progress (PPHP) series, a series that explores prospects for human development and the improvement of the global human condition. Each volume considers one key aspect of how development appears to be unfolding globally and locally, how we would like it to evolve, and how better to move it in desired directions.**

The volumes emerge from the Frederick S. Pardee Center for International Futures at the University of Denver's Josef Korbel School of International Studies. The International Futures (IFs) project has worked for more than three decades to develop and use the strongest possible long-term, multiple issue capability for exploring the future of key global issues. The philosophical basis of the IFs project includes these beliefs: (1) prediction is impossible, but forecasting is necessary to help us understand change and to support policy development; (2) analysis should be built around alternative possible futures; and (3) forecasting tools should be as open and transparent as possible.

The first PPHP volume focused on the central issue of global poverty reduction, presenting first a long-range, base case forecast—an elaboration of the path we appear to be on. It then explored an extensive set of variations in that path tied to alternative domestic and international interventions. The second volume provided a long-range, base case forecast for global advances in education participation and attainment, and then developed a normative scenario, looking for aggressive, but reasonable, patterns to enhance global advances in formal education.

This third volume drills down into arguably the most important of all issues for humans: that of health. It recognizes the remarkable epidemiologic and demographic transitions that, while long underway, have gained, lost, and regained momentum in the last 50 years. During that half century to 2010, global life expectancy increased from just over 50 years to approximately 70—yet about 20 countries have a lower life expectancy today than they did two decades ago. This volume explores where the next five decades may take us. We consider changing mortality and morbidity patterns, including the remarkable ongoing reduction of global deaths from communicable diseases, a pattern that hopefully will be consolidated and extended. We consider also the growing burden of noncommunicable diseases and injuries, especially as populations age nearly everywhere. And we examine possible alternative patterns of 15 specific causes of death and disability and their impacts.

The volume analyzes not only the drivers of change in human health, including advances in income, education, and technology, but also a number of more immediate risk factors (undernutrition, obesity, smoking, road traffic accidents, inadequate water and sanitation, indoor and outdoor air pollution, and climate change) and their health impacts. We focus heavily on the role of human effort in shaping health outcomes, as well as the roles of the natural environment and biological constraints.

Human health interacts closely with broader human development. Therefore, this volume devotes attention not only to the drivers of change in health prospects but also to the ways in which those prospects affect broader demographic and economic futures. Among the advantages of the IFs modeling system is the manner in which it links health forecasting to larger human systems.

Putting these pieces together, this volume uniquely looks forward across half a century at human health for 183 countries and the regions and groupings into which they fall, exploring a broad range of causes of disease and death, probing the deeper and more immediate drivers of change in human health prospects, and linking that analysis to the dynamics of the larger human development system. Our analysis recognizes the great uncertainty around such forecasts and attempts to explore the bases for alternative health futures and their implications. We hope this broad and deep exploration can contribute to the collective effort to assure improved health and well-being for peoples around the world. Those who wish to explore or extend our analysis will find the full IFs system at www.ifs.du.edu.

Acknowledgments

The authors again owe special thanks to Frederick S. Pardee, who conceptualized the Patterns of Potential Human Progress (PPHP) series that this volume continues. We much appreciate Fred's ongoing support for the work of the International Futures (IFs) project and his contribution of energy, enthusiasm, and ideas, including the special responsibility he has taken for the country-specific supporting data tables that accompany the PPHP volumes and appear on-line at the IFs website.

The International Futures simulation modeling system, the core tool of this volume, has been developed over 30 years under the leadership of Barry Hughes at the Josef Korbel School of International Studies, University of Denver. Thanks to the support of the University and the Frederick S. Pardee Center for International Futures, the complete system, including both a downloadable version and an on-line version, is available for all users at www.ifs.du.edu.

IFs, developed originally as an educational tool, owes much to the large number of students, instructors, and analysts who have used or reacted to the system over many years and have provided much appreciated advice for enhancement. The first two volumes of this series provided names of many of those, and without repeating the list we thank them still again (as we do earlier team members, listed also in those two volumes).

IFs team members who made special contributions to this volume include Jonathon Chesebro (data), Brent Corby (data), Eric Firnhaber (photographs), Mariko Frame (photographs), Kia Tamaki Harrold (background working papers), Mohammod Irfan (data and systems support), Josiah Marineau (data and help system), Lisa Matts (supporting research), Jonathan Moyer (web support), Britt Reiersgord (references, photographs, and more), Graham Smith (references), Mark Stelzner (data), Marc Sydnor (photographs and project support on earlier volumes that made this one easier), and Julie Thompson (supporting research). Most especially we express tremendous appreciation to Janet Dickson, who worked closely with the authors throughout the writing and production process. She brainstormed with us, kept us on task, edited the volume, and oversaw the production process.

This volume owes a special debt of gratitude to Colin D. Mathers, Mortality and Burden of Disease Coordinator, Department of Health Statistics and Informatics, World Health Organization, and a founding leader of WHO's Global Burden of Disease project. From our first approach to Dr. Mathers, requesting information about the methods of the GBD project, he was unfailingly helpful. He provided unpublished data from the project and the coefficients used in its formulations, and he patiently answered our questions about the GBD project's methods and approaches. He also reviewed the penultimate manuscript and provided feedback that has saved us from many errors.

We also thank an exceptional group of external reviewers who greatly enhanced this volume through their feedback. They are Jere R. Behrman, William R. Kenan Jr. Professor of Economics and Sociology, University of Pennsylvania; Henk Hilderink, Senior Policy Researcher, Department of Sustainable Development, Netherlands Environmental Assessment Agency (PBL); Gerald Keusch, Professor of Medicine and International Health, Special Assistant for Global Health to the University President, Boston University; Rachel Nugent, Deputy Director of Global Health, Center for Global Development; and Sam Preston, Fredrick J. Warren Professor of Demography, University of Pennsylvania. No one could save us from all of our errors of omission and commission, but they caught many.

Most recent funding for IFs has come from Frederick S. Pardee, the United Nations Environment Programme, the U.S. National Intelligence Council, and the European Commission. Other developments within International Futures have been funded in part by the Strategic Assessments Group of the U.S. Central Intelligence Agency, by the Frederick S. Pardee Center for Longer Range Global Policy

and the Future of the Human Condition at RAND Corporation, and by the European Union Center at the University of Michigan. Thanks also to the National Science Foundation, the Cleveland Foundation, the Exxon Education Foundation, the Kettering Family Foundation, the Pacific Cultural Foundation, the United States Institute of Peace, and General Motors for funding that contributed to earlier generations of IFs.

At Paradigm Publishers, Jennifer Knerr, longtime editor and friend of the IFs project, was wonderfully helpful and supportive, and the hands-on editorial guidance provided by Carol Smith and Jeska Horgan-Kobelski was invaluable. At Oxford University Press in New Delhi, we are grateful for the warm support and partnership of Neha Kohli, Associate Development Editor, and Urmilla Dasgupta, Commissioning Editor. We are extremely appreciative of the beautiful design and layout work on all of the series volumes by Trevor Bounford and Denise Goodey of Bounford.com. And with this volume, we were extremely fortunate to welcome Eleanora von Dehsen to our team; we much appreciate her help in standardizing our presentation.

Finally, the authors built on tremendous foundations of work directed toward improving global health. The hope that motivated our work was that we might contribute something to that ongoing stream of effort by exploring the possible trajectory of global health and its broader human development consequences over the next 50 years. Other than the authors, of course, none of the named individuals or institutions bears any responsibility for the current status of the model or for the analysis presented here. Their support is nonetheless greatly appreciated.

Barry B. Hughes
Series Editor

Contents

List of Boxes xi

List of Figures xi

List of Tables xiv

Abbreviations and Acronyms xvi

1 The Story So Far 1

Recent Progress and Significant Challenges 1

Understanding the Story So Far 3

Understanding and Shaping the Story Going Forward 4

Why This Volume? 6

Conclusion 8

2 Understanding Health: Concepts, Relationships, and Dynamics 9

Measuring the Disease Burden 10

Observing mortality 10

Summarizing mortality 12

Observing morbidity 13

Measures of disease occurrence 14

Measures of overall morbidity 15

Combining morbidity and mortality into a single measure 15

Understanding Health Outcomes 16

Distal Drivers of Health 17

Income 18

Education 19

Time and its underlying elements 20

More Proximate Determinants of Health 20

Super-Distal Drivers and the Broader Uncertainty Context of Health 22

Technology and biological limits 23

The social environment 24

Domestic health expenditures and other social influences on health 24

Global health initiatives 26

The natural environment 27

Conclusion 27

3 Forecasting Global Health 29

Integrating Health with Broader Human Development: The Larger IFs System 30

All-Cause Mortality Models 32

The Emergence and Development of Structural Models 34

Global burden of disease 34

Comparative risk assessment and forecasting 35

Specialized disease-cause models and systems dynamics approaches 36

GISMO: Integrating structural and dynamic representations 36

Returning to the general purposes of existing forecasting approaches 37

Building a hybrid, integrated system 38
Modeling Health in IFs 39
The GBD (mostly distal driver) model foundation in IFs 39
Specialized structural model formulations and approaches in IFs 41
Smoking, smoking impact, and chronic diseases 41
HIV/AIDS 42
Road traffic accident deaths 43
Public spending on health 44
Model extensions to include proximate drivers in IFs 44
The basic proximate-driver approach in IFs 44
Mapping proximate drivers to diseases and age categories 45
An example of the proximate-driver approach in IFs: Undernutrition 46
Dealing with multiple risk factors 47
Other proximate-driver modifications of distal formulations 47
Disability and DALYs 48
Conclusion 49

4 The Current Path as It Seems to Be Unfolding 52
The Base Case 52
Life expectancy 53
Changing disease burden 56
Attention to global goals 58
Comparison with Other Forecasts 61
Life expectancy forecasts: United Nations Population Division 61
Death and disability forecasts: GBD project 62
Child mortality and death cause forecasts: GISMO 63
HIV and AIDS forecasts: UNAIDS 64
Road traffic accident deaths: World Bank and GBD 66
Framing Scenario Analysis 67
Alternative futures for GDP per capita and education 67
Alternative futures for time/technology 69
Conclusion 70

5 Analysis of Selected Proximate Risk Factors 72
Health Risk Transition 73
Risk Analysis with IFs 73
Childhood Undernutrition 74
Drivers and forecasts of undernutrition in children 75
Childhood undernutrition and mortality: Alternative scenarios 77
Overweight and Obesity 78
Drivers and forecasts of obesity 78
Adult BMI and related mortality: Alternative scenarios 80

Tobacco Use 82
Drivers and forecasts of tobacco use 82
Tobacco use and related mortality: Alternative scenarios 84
Vehicle Ownership and Safety 85
Drivers and forecasts of vehicle ownership 85
Vehicle ownership, fatality rates, and related mortality: Alternative scenarios 86
Conclusion 87

6 Analysis of Selected Environmental Risk Factors 90
Environmental Risk Factors and the Environmental Risk Transition 91
The Environment and Human Health: The Empirical Evidence 92
Environment and Human Health: Risk Factors Now and in the Future 95
Water, sanitation, and hygiene 95
Drivers and forecasts of access to improved drinking water and sanitation 96
Improved drinking water and sanitation: Health effects under alternative scenarios 97
Indoor air pollution 97
Drivers and forecasts of solid fuel use for heating and cooking 98
Indoor air pollution: Health effects under alternative scenarios 99
Urban outdoor air pollution 100
Drivers and forecasts of urban air quality 100
Urban outdoor air pollution: Health effects under alternative scenarios 101
Climate change 102
The potential health impacts of climate change 103
Climate change: Health effects under alternative scenarios 105
Comparing and Combining Analyses of Proximate Risk Factors 108
Comparative risk analysis 108
Combined risk analysis: WHO and World Bank approach 109
Combined risk analysis: The IFs approach 110
Conclusion 111

7 Forward Linkages 114
From Health to Growth 115
A core controversy 115
Empirical analysis 115
Decomposing the pathways between health and growth 116
The Paths of Forward Linkages from Health to Economic Growth 117
Health and labor 117
Health and productivity 119
Immediate effects of disability on productivity 119
Delayed effects of disability on productivity 120
Macro analysis of health and productivity 121
Health and productivity in IFs 121

Health and capital stocks 123
Health expenditures: Competition with savings 124
Longevity, the incentive to save, and the supply of investment 124
Health and capital stock in IFs 125
Exploring Forward Linkages 126
The interventions 126
The aggregate demographic and economic effects of the interventions 127
Exploring paths between health and growth: Demographics and labor supply 129
Exploring paths between health and growth: Productivity 130
Exploring paths between health and growth: Savings and capital 133
Conclusions concerning the three paths between health and economic growth 134
Returning to the intrinsic benefits of health 135
Conclusion 135

8 Broadening and Integrating Our Perspective 138
How Might We Characterize Our Base Forecasts? 140
Historical patterns as a reference point 140
Communicable disease futures 142
Noncommunicable disease futures 143
Summary characterization and adjustment of the base case 144
Alternative Health Futures: Integrated Scenario Analysis 146
Building the scenarios 147
Contrasting Luck and Enlightenment versus Things Go Wrong 148
Disease burden patterns across alternative health futures 149
The summary implications for life expectancy 152
The economic consequences of alternative health futures 153
Conclusion 154

9 The Future of Global Health 156
Expanding Capability for Health Forecasting 156
Understanding the Future of Global Health 157

Appendix: Countries in IFs by World Bank Developing Region and Economy Classification 161
Bibliography 163
Forecast Tables: Introduction and Glossary 183
Forecast Tables: Maps of Continents and Subregions 189
Forecast Tables 193
Index 336
Author Notes 345

List of Boxes

Box 2.1	The J-curve of mortality patterns	12
Box 2.2	Undernutrition and diarrheal disease in developing countries: An example of the interrelationship of distal and proximate drivers of health	21
Box 2.3	Prospects for human longevity: A debate	24
Box 4.1	The base case of IFs	53
Box 4.2	Groupings of country-level data and forecasts	55
Box 4.3	Will the large and rapidly developing BRICs (Brazil, Russia, India, and China) catch up with the high-income countries?	58
Box 4.4	Alternative forecasts	69
Box 5.1	Risk factor variability and exploring potential impacts of interventions in IFs	74
Box 6.1	Understanding different forecasts of climate change impact on health	108
Box 7.1	HIV/AIDS and fertility	119
Box 7.2	The extent of child stunting	121
Box 8.1	Summary of Luck and Enlightenment and Things Go Wrong scenarios	147

List of Figures

Figure 1.1	Infant mortality rates by region (1960 and 2005)	2
Figure 1.2	Probability of child and adult mortality by region (2005)	2
Figure 1.3	Stages of the epidemiologic and demographic transitions	3
Figure 1.4	Trends in maximum female life expectancy (1840–2000)	4
Figure 2.1	J-curve and mortality pyramid (Bangladesh, 2005)	11
Figure 2.2	Survival curve and simplified life expectancy calculation (Bangladesh, 2005–2010)	12
Figure 2.3	Global female mortality and DALY rates by age and major disease group (2004)	16
Figure 2.4	Drivers of health and disease	17
Figure 2.5	Relationship of life expectancy at birth and GDP per capita at PPP	18
Figure 2.6	Changes in the relationship between life expectancy and income per capita over time	19
Figure 3.1	Major models in the IFs modeling system and example connections	31
Figure 3.2	Risk factors and health outcomes in the GISMO integrated model	37
Figure 3.3	Envisioning a hybrid and integrated health forecasting approach	38

Figure 4.1	Life expectancy for males and females by region: History and extended forecasts	54
Figure 4.2	Life expectancy gap between countries with the longest and shortest life expectancies	55
Figure 4.3	Global deaths (millions) by major communicable diseases	56
Figure 4.4	Communicable disease mortality across age categories and time: Sub-Saharan Africa and high-income countries	57
Figure 4.5	Noncommunicable disease mortality across age categories and time: Sub-Saharan Africa and high-income countries	57
Figure 4.6	Global deaths, years of life lost, and years of living with disability by major disease groups	59
Figure 4.7	Infant and adult mortality rates over time and regions	60
Figure 4.8	GISMO forecasts of child mortality in 2015 and 2030	64
Figure 4.9	GISMO and IFs forecasts of child deaths (millions) due to diarrhea	65
Figure 4.10	Global life expectancy forecasts across three economic growth-rate scenarios	68
Figure 5.1	The transition in health risk factors over time	73
Figure 5.2	Underweight children (percent) as a function of GDP per capita at PPP	74
Figure 5.3	Underweight children (percent) by country economy classification	77
Figure 5.4	Difference in forecasts of child deaths (thousands) between scenarios with slower and faster improvements in access to adequate nutrition (by region)	77
Figure 5.5	Body mass index as a function of calorie availability for females age 30 and older	79
Figure 5.6	Percent of obese male and female adults age 15–59 by region (2060)	80
Figure 5.7	Global mortality rates related to cardiovascular diseases and diabetes across age categories and time	80
Figure 5.8	Difference in forecasts of deaths (thousands) of adults 30 years of age and older related to cardiovascular diseases and diabetes under high versus low BMI scenarios (by region)	81
Figure 5.9	Difference in forecasts of life expectancy between high and low BMI scenarios by country economy classification	82
Figure 5.10	Adult smoking prevalence by sex and country economy classification: History and forecasts	84
Figure 5.11	Difference in forecasts of deaths (thousands) by region related to malignant neoplasms, cardiovascular diseases, and chronic respiratory conditions and diseases under high versus low smoking scenarios (2060)	85
Figure 5.12	Adult mortality probability from road traffic accidents by country economy classification	86
Figure 5.13	Difference in forecasts of adult deaths (thousands) related to road traffic accidents under road traffic safety favorable scenario versus base case forecast (by region)	87
Figure 6.1	The environmental risk transition	92
Figure 6.2	Number and percent of global DALYs attributable to environmental risk factors by country income level (2004)	94

Figure 6.3	Global DALYs attributable to water, sanitation, and hygiene (WSH), indoor air pollution (IAP), and outdoor air pollution (OAP) by GDP per capita (2004)	94
Figure 6.4	Percent of population by region without access to improved drinking water and sanitation	96
Figure 6.5	Difference in forecasts of child deaths (thousands) from diarrheal diseases between scenarios with slow and fast improvements in access to improved water and sanitation (by region)	97
Figure 6.6	Percent of population using solid fuel in the household (by region)	99
Figure 6.7	Difference in forecasts of child deaths (thousands) from respiratory infections between scenarios with slow and fast improvements in exposure to indoor air pollution (by region)	99
Figure 6.8	Difference in forecasts of deaths (thousands) in adults over 30 from respiratory diseases between scenarios with slow and fast improvements in exposure to indoor air pollution (by region)	100
Figure 6.9	Population-weighted average annual urban $PM_{2.5}$ concentrations (by region)	101
Figure 6.10	Difference in forecasts of deaths (thousands) in adults over 30 from cardiopulmonary diseases between scenarios with slow and fast improvements in urban air quality (by region)	102
Figure 6.11	Climate change and health: Impacts and pathways	103
Figure 6.12	Climate change impacts via effects on crop yields in Nigeria: Base case and "no CO_2 fertilization" scenario compared to "no climate change impact" scenario (percentage differences in 2060)	107
Figure 6.13	Difference in forecasts of deaths (thousands) of children under five from communicable diseases other than HIV/AIDS due to climate change impacts on crop yields	107
Figure 7.1	Two general paths between health and economic growth	115
Figure 7.2	Elaborated paths between health and economic growth	117
Figure 7.3	Pathways linking health and demography	118
Figure 7.4	Pathways between health and productivity	119
Figure 7.5	Pathways between health and capital stock	123
Figure 7.6	High and low global mortality rate profiles, all causes, 2060	127
Figure 7.7	Years of life lost (YLLs) over time by major disease group in high and low mortality profiles: Sub-Saharan Africa and high-income countries	127
Figure 7.8	Size of global population with high and low mortality profiles (full century)	128
Figure 7.9	Ratio of economy size: Low mortality profile compared to high mortality profile by region (2060)	129
Figure 7.10	Working-age population as percent of total population: Selected country groups	130
Figure 7.11	Working years with disability per worker across high and low mortality profiles: Sub-Saharan Africa and high-income countries	131
Figure 7.12	Stunting rate in sub-Saharan Africa with high and low mortality profiles	132
Figure 7.13	Government retirement and pension payments (global) as portion of GDP under high and low mortality profiles	132

Figure 7.14 Ratios of GDP per capita of assorted changes to high mortality profile by region (2060) 135
Figure 7.15 Human Development Index (HDI) across mortality profiles: South Asia and sub-Saharan Africa 136
Figure 8.1 Alternative health futures in broad context 139
Figure 8.2 Historical trends in life expectancy and lifespan of high longevity segments: Sweden, 1860–2004 140
Figure 8.3 Life expectancy: Ratio of low- and middle-income countries to high-income countries (1960–2005) 141
Figure 8.4 Axes of alternative health futures and the IFs base case 145
Figure 8.5 Comparison of mortality probabilities (expressed as probable deaths per 1,000) for 2060 in the base case and the adjusted base case 146
Figure 8.6 Global mortality by major cause of death across Luck and Enlightenment (L&E) and Things Go Wrong (TGW) scenarios and adjusted base case 149
Figure 8.7 Annual death differences between Luck and Enlightenment and Things Go Wrong scenarios by death cause-group and region 150
Figure 8.8 Annual child deaths in Luck and Enlightenment (L&E) versus Things Go Wrong (TGW) scenarios for low-income and lower-middle-income countries 151
Figure 8.9 Comparison of mortality probabilities for 2060 in Luck and Enlightenment (L&E) and Things Go Wrong (TGW) by region 152
Figure 8.10 Life expectancy in Luck and Enlightenment (L&E) and Things Go Wrong (TGW) scenarios: History and forecasts for selected country groupings 153
Figure 8.11 GDP per capita (PPP) ratios in 2060 of the Luck and Enlightenment scenario to the adjusted base case 154

List of Tables

Table 2.1 Proximate health risk factors included in the World Health Organization's Comparative Risk Assessment project 22
Table 3.1 Risk factors and their disease impacts in IFs 46
Table 3.2 Percent changes in disability relative to declines in mortality by cause in IFs 49
Table 4.1 Life expectancy of females in globally leading country: History and forecast 56

Table 4.2	Probable number of 15-year-olds per 1,000 dying before age 60: BRICs and high-income countries	58
Table 4.3	UNPD and IFs life expectancy forecasts in years by region	61
Table 4.4	UNPD and IFs forecasts of countries with longest life expectancies	62
Table 4.5	GBD and IFs forecasts of regional deaths (millions) in 2030 by major disease group	62
Table 4.6	GBD and IFs forecasts of DALYs (millions) in 2030 by major disease group	63
Table 4.7	Spectrum and IFs forecasts of HIV prevalence and AIDS deaths for countries with highest numbers of deaths	66
Table 4.8	Estimates and forecasts of road traffic fatalities (thousands) by region using three forecasting systems	67
Table 5.1	FAO and IFs forecasts of available calories per capita by region	76
Table 6.1	Global deaths and DALYs attributable to environmental risk factors in 2004	93
Table 6.2	Global projections of health impacts of urban air pollution in the baseline scenario of the OECD environmental outlook to 2030	102
Table 6.3	Burden of disease (deaths and DALYs) due to global climate change by disease category, region, and age (2004)	105
Table 6.4	Cumulative differences in global forecasts of deaths, YLLs, and DALYs between less and more favorable scenarios of individual proximate risk factors (2005–2060)	109
Table 6.5	Global reduction in deaths between 2010 and 2060 by disease group with near-immediate shift to theoretical minimum risk levels	110
Table 7.1	Capital stock per worker (thousands of dollars) by region under high and low mortality profiles (2060)	133

Abbreviations and Acronyms

AIDS	acquired immune deficiency syndrome
ARI	acute respiratory infection
ART	Antiretroviral therapy
BMI	body mass index
BRICs	Brazil, Russia, India, and China
CDC	Centers for Disease Control
CDs	communicable diseases
CEC	Commission for Environmental Cooperation
CO_2	carbon dioxide
COPD	chronic obstructive pulmonary disease
CRA	Comparative Risk Assessment project (WHO)
CSDH	Commission on Social Determinants of Health (WHO)
CVD	cardiovascular disease
DALYs	disability-adjusted life years
DHS	Demographic and Health Surveys (USAID)
EC	European Commission
EPP	Estimation and Projection Package
FAO	Food and Agriculture Organization (UN)
GBD	Global Burden of Disease project (WHO)
GDP	gross domestic product
GHIs	Global Health Initiatives
GISMO	Global Integrated Sustainability Model
GMAPS	Global Model of Ambient Particulates
GNI	gross national income
GUAM	Global Urban Air quality Model
HDI	Human Development Index
HIV	human immunodeficiency virus
IAP	indoor air pollution
ICD	International Classifications of Disease
ICSU	International Council for Science
IFs	International Futures computer simulation model
IHRs	International Health Regulations
IIASA	International Institute for Applied Systems Analysis
IPCC	Intergovernmental Panel on Climate Change
LEB	life expectancy at birth
LES	linear expenditure system
MDGs	Millennium Development Goals (UN)
MICS	Multiple Indicator Cluster Survey (UNICEF)
NCDs	noncommunicable diseases
NGOs	non-governmental organizations
OAP	outdoor air pollution
OECD	Organisation for Economic Co-operation and Development
OLS	ordinary least squares
PAF	population attributable fraction
$PM_{2.5}$	particulates with a diameter of 2.5 micrometers or less
PM_{10}	particulates with a diameter of 10 micrometers or less
ppm	parts per million
PPP	purchasing power parity
RR	relative risk
SAM	social accounting matrix
SI	smoking impact
SIR	smoking impact ratio
UNEP	United Nations Environment Programme
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UNPD	United Nations Population Division
USNIC	United States National Intelligence Council
WDI	World Development Indicators (World Bank)
WHO	World Health Organization
WHOSIS	World Health Organization Statistical Information System
WHS	World Health Survey (WHO)
WSH	water, sanitation, and hygiene
YLDs	years lived with disability
YLLs	years of life lost